TWIN DISC
INCORPORATED

Service Manual

Marine Transmission

Components:
MGX5114A

Document Number: 1021303

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Marine Transmission Operator's Manual

TWIN DISC, INCORPORATED
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MARINE PLEASURE CRAFT

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1. Complete parts or products upon request must be returned transportation prepaid and also the claims submitted to Twin Disc, Incorporated within sixty (60) days after completion of the in-warranty repair.
2. The warranty is void if, in the opinion of Twin Disc, Incorporated, the failure of the part or product resulted from abuse, neglect, improper maintenance or accident.
3. The warranty is void if any modifications are made to any product or part without the prior written consent of Twin Disc, Incorporated.
4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.
5. The warranty is void unless the product or part is properly installed and maintained within the rated capacity of the product or part with installations properly engineered and in accordance with the practices, methods and instructions approved or provided by Twin Disc, Incorporated.
6. The warranty is void unless all required replacement parts or products are of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Replacement parts or products not of Twin Disc origin are not warranted by Twin Disc, Incorporated.

C. As consideration for this warranty, the original customer and subsequent purchaser agree to indemnify and hold Twin Disc, Incorporated harmless from and against all and any loss, liability, damages or expenses for injury to persons or property, including without limitation, the original customer*s and subsequent purchaser*s employees and property, due to their acts or omissions or the acts or omissions of their agents, and employees in the installation, transportation, maintenance, use and operation of said equipment.

D. Only a Twin Disc, Incorporated authorized factory representative shall have authority to assume any cost or expense in the service, repair or replacement of any part or product within the warranty period, except when such cost or expense is authorized in advance in writing by Twin Disc, Incorporated.

E. Twin Disc, Incorporated reserves the right to improve the product through changes in design or materials without being obligated to incorporate such changes in products of prior manufacture. The original customer and subsequent purchasers will not use any such changes as evidence of insufficiency or inadequacy of prior designs or materials.

F. If failure occurs within the warranty period, and constitutes a breach of warranty, repair or replacement parts will be furnished on a no-charge basis and these parts will be covered by the remainder of the unexpired warranty which remains in effect on the complete unit.

TWIN DISC, INCORPORATED
FLAT RATE HOUR ALLOWANCE
MARINE PLEASURE CRAFT

(Hourly Labor Rates Must Be Acceptable to Twin Disc, Incorporated)

MODEL SERIES	R&R	UNIT REBUILD
MG340, MG360	0.0	0.0
MG502, MG5010, MG5011, MG5005A, MG5015A	10.0	8.0
MG506, MG5050, MG5061, MG5062, MG5055A	10.0	11.0
MG507, MG5081, MG5085, MG5090, MG5091	10.0	12.0
MG509, MG5111, MG5112, MG5114	10.0	17.0
MG514C, MG5141	10.0	25.0
MG5202, MG5203, MG5204, MG5222 MG5225	10.0	32.0
MG6000	10.0	32.0
MGN80, MGN232, MGN233, MGN272, MGN273, MGN332, MGN334, MGN335, MGN432, MGN433, MGN472, MGN493	10.0	32.0
PUMP - ALL MODELS EXCEPT MG340 & MG360	1.0	-
VALVE - ALL MODELS EXCEPT MG340 & MG360	1.0	.5

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Introduction

General Information

This publication provides service information for the Twin Disc model MGX-5114A marine transmissions. Specific engineering details and performance characteristics can be obtained from the Product Service Department of Twin Disc, International S.A., Nivelles, Belgium, or Twin Disc, Incorporated, Racine, Wisconsin, USA.

Operation and maintenance personnel responsible for this equipment should be familiar with this publication and have it at their disposal. A thorough understanding and application of the material in this manual will result in consistent performance from the unit and help reduce downtime.

Safety and General Precautions

General

All personnel servicing this equipment should employ safe operating practices. Twin Disc, Inc. will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unaccepted maintenance/ working practices.

Important Safety Notice

Proper installation, maintenance, and operation procedures must be followed due to the possible danger to person(s) or property from accidents that may result from the use of machinery. Twin Disc, Inc. will not be responsible for personal injury resulting from careless maintenance/working practices.

Inspect as necessary to assure safe operations under prevailing conditions. Proper guards and other safety devices that may be specified in safety codes should be provided. These devices are neither provided by, nor are they the responsibility of Twin Disc, Inc.

⚠ WARNING

Selecting NEUTRAL disengages transmission clutches but does not prevent propeller shaft rotation. If you require positive neutral (propeller shaft locked), a shaft brake or other shaft-locking device must be used.

⚠ WARNING

To prevent accidental starting of the engine when performing routine transmission maintenance, disconnect the battery cables from the battery and remove ignition key from the switch.

⚠ WARNING

Most Twin Disc products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the Twin Disc product. These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

⚠ CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

Preventative Maintenance

Frequent reference to the information provided in the Marine Transmission Operator's Manual, 1016313, regarding daily operation and limitations of this equipment will assist in obtaining trouble-free operation. Schedules are provided for recommended maintenance of the equipment.

Backdriving or Towing

Backdriving (also called windmilling) occurs when an engine is shut down and the propeller shaft is being driven by the flow of water across the propeller, which, in turn, rotates the components in the marine transmission. During prolonged backdriving conditions, the transmission does not receive proper lubrication.

Conditions where backdriving may occur:

- ❑ Vessel is being towed.
- ❑ One or more engines on a multiple-transmission vessel are shut down while under way.
- ❑ Sailboat under sail with auxiliary engine shut down.
- ❑ Vessel tied up or docked in a heavy current.

Any of the following solutions are applicable for all MGX-5114A transmissions if any of the above conditions are present:

- ❑ Lock the propeller shaft to prevent rotation.

⚠ WARNING

If a clutch pack has been damaged, causing heavy drag, the prop shaft must be locked in place to prevent backdriving. The dragging clutch can produce high amounts of heat, and further damage can occur.

- ❑ Add an electric-driven auxiliary oil pump into the lubrication circuit.

Refer to the hydraulic system prints for more details on auxiliary pump specifications for the applicable transmission, or contact your Twin Disc Authorized Distributor.

- ❑ Operate the engine for five minutes once every eight hours with the oil at the proper level.
- ❑ If the engine is inoperable, plug the dip stick tube and completely fill the transmission with oil, and drain oil back down to the normal operating level. Repeat this operation every eight hours.

Ordering Parts and Obtaining Services

⚠ WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Service Parts

Renewal parts, service parts kits, optional equipment and product service assistance may be obtained from any authorized Twin Disc distributor or service dealer. Contact Twin Disc for the distributor or service dealer near you.

Note: Do not order parts from the part numbers on the cross-sectional drawings. These numbers may be referenced for part identification; however, they should be verified on the bill of material (BOM) before an order is placed. BOM numbers are stamped on the unit nameplate.

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, emanating from any of the above stated changes will not be accepted for credit. Furthermore, any equipment that has been subjected to such changes will not be covered by a Twin Disc warranty.

Source of Service Information

For the latest service information on Twin Disc products, contact any Twin Disc distributor or service dealer. This can be done on the Twin Disc corporate web site found at [http://www.twindisc.com]. Provide your model number, serial number and bill of material number to obtain information on your unit. If necessary, contact the Product Service Department of Twin Disc, International S.A., Nivelles, Belgium, or Twin Disc, Incorporated, Racine, Wisconsin, 53405-3698, USA by e-mail at service@twindisc.com.

Warranty

Equipment for which this manual was written has a limited warranty. For details of the warranty, refer to the warranty statement at the front of this manual. For details of the warranty, contact any Twin Disc Authorized Distributor, service dealer, or the Warranty Administration Department, Twin Disc, Inc., Racine, Wisconsin, U.S.A.

Description and Specifications

General

The MGX-5114A is a “Quickshift” configuration reverse and reduction Marine Transmission, having a 7° down-angle for near level engine installation. The MGX 5114A offers conical-helical gearing for quieter operation and is currently available in the following ratios: 1.03:1; 1.20:1; 1.48:1; 1.75:1, 1.92:1, 2.04:1, and 2.50:1.

These transmissions are controlled by hydraulics through the electronic control module. Both the primary and the secondary clutches are operated by main pressure oil supply. The bearings, clutches, and gears are lubricated and cooled with low pressure oil.

Nameplate

The nameplate identifies the model, bill of material (BOM) and the serial number of the unit. These numbers are necessary to identify the correct parts for your transmission.

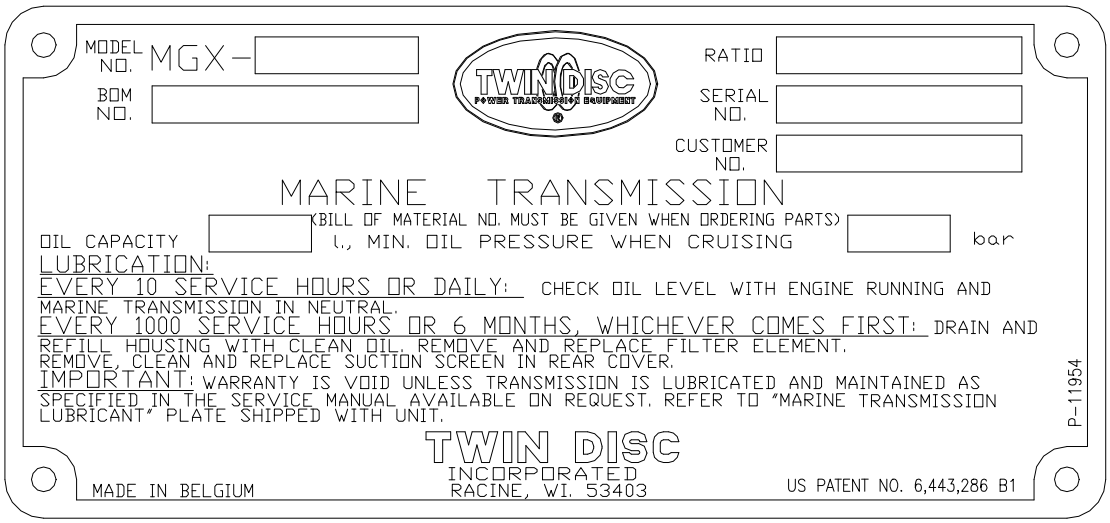

MODEL NO. MGX–
BOM NO.
TWIN DISC
POWER TRANSMISSION EQUIPMENT
RATIO
SERIAL NO.
CUSTOMER NO.
MARINE TRANSMISSION
(BILL OF MATERIAL NO. MUST BE GIVEN WHEN ORDERING PARTS)
OIL CAPACITY
l., MIN. OIL PRESSURE WHEN CRUISING
bar
LUBRICATION:
EVERY 10 SERVICE HOURS OR DAILY: CHECK OIL LEVEL WITH ENGINE RUNNING AND MARINE TRANSMISSION IN NEUTRAL.
EVERY 1000 SERVICE HOURS OR 6 MONTHS, WHICHEVER COMES FIRST: DRAIN AND REFILL HOUSING WITH CLEAN OIL. REMOVE AND REPLACE FILTER ELEMENT. REMOVE, CLEAN AND REPLACE SUCTION SCREEN IN REAR COVER.
IMPORTANT: WARRANTY IS VOID UNLESS TRANSMISSION IS LUBRICATED AND MAINTAINED AS SPECIFIED IN THE SERVICE MANUAL AVAILABLE ON REQUEST. REFER TO "MARINE TRANSMISSION LUBRICANT" PLATE SHIPPED WITH UNIT.
TWIN DISC
INCORPORATED
RACINE, WI. 53403
MADE IN BELGIUM
US PATENT NO. 6,443,286 B1
P-11954

Figure 1. Example of Nameplate.

Power Ratings

The MGX-5114A transmission can be operated through either the primary shaft or secondary shaft at its full rated horsepower when driven by a standard right hand rotation engine (counterclockwise flywheel rotation direction when viewing rear of engine).

Always reference the Bill of Materials (BOM) or Specification number when ordering service parts.

Changing Rotation

When shipped form the factory, each unit is designated for use with a particular engine rotation. Within their rated capacities, these units may be operated continuously in either forward or reverse.

The unit can be adapted to either left or right-hand engine rotation. To adapt to opposite engine rotation, remove the heat exchanger hose from the rear end of the pump. Remove the pump, turn it 180° and reinstall it. Remove the plug from the rear of the pump and install where the heat exchanger hose was. Install the heat exchanger hose where the plug was. When changing from RH rotation to LH rotation install an engine rotation plate (Arrow) to indicate the new direction of rotation.

Direction of Drive

The primary (input) clutch shaft and driving transfer gear always rotates in engine direction. The secondary clutch shaft and driven transfer gear always rotate in anti-engine direction because the driven transfer gear is meshed with the driving transfer gear on the primary clutch shaft. When the primary clutch is engaged, the primary input pinion rotates in engine direction. The output gear, which is secured to the output shaft, is meshed with the primary input pinion and so the output gear and shaft are driven in anti-engine direction. When the secondary clutch is engaged, the secondary input pinion rotates in anti-engine direction. The output gear is meshed with the secondary input pinion and, therefore, the output gear and shaft are driven in engine direction.

Construction Features

Housings

The MGX-5114A housing consists of a front SAE 1 or SAE 2 housing and a rear half housing. They are sealed together with a gasket.

Taper Roller Bearings

The primary, secondary, and output shafts have taper roller bearing which require shimming to adjust the endplay of the respective shafts.

Oil Pump Drive

The oil pump is tang-connected and driven by the secondary clutch shaft.

Lubrication Features

Oil is directed by the control valve through horizontal drillings in the primary and secondary clutch shafts to orifices through which the front and rear roller bearings on the primary and secondary clutch shafts are lubricated. There are also orifices in the shafts through which both clutches are cooled.

Suction Strainer

The marine transmission has a serviceable suction strainer located below the oil pump. The strainer is between the sump and the oil pump in the hydraulic circuit. The strainer can be replaced if necessary.

Filter Assembly

A spin-on oil filter is located between the heat exchanger outlet and the selector valve in the hydraulic circuit. The replacement element is Twin Disc part number PM11652A. This should be replaced at 1000 hour or six month intervals, whichever comes first.

Gears

All gears are helical, carburized, hardened and ground for smooth quiet operation. All gears are in constant mesh. The primary and secondary transfer gears and the output gear are mounted on keyless tapers.

Flexible Torsional Input Coupling

The purpose of the torsional coupling is to transmit power from the engine to the marine transmission through a rubber or silicone element that will:

- ❑ Dampen torsional vibrations
- ❑ Change the natural frequencies of a system to move critical frequencies out of the operating speed range
- ❑ Accommodate a certain amount of misalignment
- ❑ Absorb shock and reduce noise
- ❑ Minimize gear “rattle”

Several couplings are available from Twin Disc, and are selected based on the customer supplied engine information. Final coupling selection must be confirmed by the packager based on the torque/rpm ratings and the results of the system torsional vibration analysis (TVA), and on engine rotation. Care must be taken when servicing that replacement couplings are matched to this criteria.

Heat Exchanger

The heat exchanger is designed to maintain the oil in the hydraulic system of the marine transmission at the proper temperature by passing raw or fresh water through the heat exchanger. The heat exchanger should be installed in a location convenient to both coolant and marine transmission oil.

Table 1. Heat Exchanger Requirements

HEAT EXCHANGER (H.E.) REQUIREMENTS				
PERMISSIBLE OIL TEMPERATURE INTO HEAT EXCHANGER				
RATIO	OIL VISCOSITY	MAX.	MIN.	
2.54: 1 & 3.09: 1	SAE 30	85° C (185° F)	66° C (150° F)	
2.54: 1 & 3.09: 1	SAE 40	99° C (210° F)	80° C (175° F)	*
1.12, 1.50, 2.04 & 1.74: 1	SAE 40	85° C (185° F)	66° C (150° F)	
MIN. HEAT TRANSFER CAPACITY (MULTIPLY BY 1.25 FOR FRESH AND 2.0 FOR RAW WATER H.E.)	KW (BTU/MIN) PER ENGINE RTD. H.P.			
	CONTINUOUS DUTY .026 (1.484)	P.C. & INT. DUTY .022 (1.272)		
APPROX. OIL FLOW TO H.E.	1.5 L/MIN (.40 GPM) PER 100 ENGINE R.P.M.			
PEAK OIL PRESSURE AT H.E. (PROOF TEST H.E. AT 1.5 X KPa (PSI)	1965 KPa (285 PSI)			
MAX. ALLOWABLE OIL PRESSURE DROP ACROSS H.E. WITH 66mm²/sec (300) SUS OIL AT RATED ENGINE R.P.M.	207 KPa (30 PSI)			
WATER FLOW TO H.E. - USE 1.5 TO 3.0 TIMES OIL - L/MIN. (GPM)				
H.E. WATER PRESSURE RATING, MIN., = 1.5 X H.E. INLET WATER KPa (PSI)				
DATA H.E. PURCHASER MUST ALSO TELL VENDOR				
STATE IF RAW (OPEN CHANNEL & SEA) OR FRESH (CLOSED ENGINE JACKET * & (KEEL COOLER) WATER WILL COOL H.E.				
STATE MAX. WATER TEMP. INTO H.E. — TYPICAL — RAW WATER - 29° C (85° F), KEEL COOLER WATER - 60° C (140° F), ENGINE JACKET WATER * - 82° C (180° F)				
STATE MIN., ALSO MAX. L/MIN. (GPM) OF WATER FLOW TO H.E.				
H.E. INSTALLATION & SERVICE REQUIREMENTS				
OIL LINES, TRANSMISSION TO H.E. AND RETURN —— (1) MAX. VELOCITY IN FITTINGS, PIPE, HOSE AND TUBES-7.6m/sec (25FT./SEC.) (2) BURST PRESSURE, MIN., = 10 x PEAK OIL PRESSURE AT H.E. (3) HOSE - SAE J517 100R1 MEETING USCG 46CFR 56.60-25 (C), 135° C (275° F) TEMP. RATING (4) PROTECT LINES FROM MECHANICAL DAMAGE. ZINC ANODES PROTECT H.E. RAW WATER PASSAGES FROM CORROSION. CHECK & REPLACE THEM FREQUENTLY.				

* MEANS THE ENGINE JACKET WATER CAN BE USED FOR THIS APPLICATION ONLY IN ADDITION TO FRESH (KEEL COOLER) OR RAW WATER APPLICATIONS.

Specifications

Maximum operating speed: 3000 rpm

Maximum oil sump temperature: 85° C (185° F)

Operating temperature range: 66° - 85° C (150° - 185° F)

Oil type and viscosity: SAE viscosity number 40, meeting SAE-API service class CD engine oil certified to meet TO-2 transmission oil specification or type C-3 transmission fluid. Also approved is SAE-API service class CC engine oil.

Note: Multi-viscosity oils (i.e. 10W-30W, etc) must not be used in TWIN DISC Marine Transmissions.

Oil Capacity: 7.6 Liters (2.0 US Gallons) plus volume in hoses and heat exchanger.

Approximate Dry Weight: 205 Kg (94 Lbs.) excluding heat exchanger, hoses, companion flange, and trolling valve.

Oil Pump Capacity: 45.4 Liters/min (12 gpm).

Oil pressure: See following tables. Oil temperature to be in the normal operating range.

Electronic Control Module operating voltage range. 9 to 32 Volts DC

Electronic Control Module operating temperature range.
-40° C (-40° F) to 85° C (185° F)

Output Speed Sensor airgap: Two turns out from touching the o.d. of the speed wheel.

Input Speed Sensor airgap: One turn out from touching o.d. of transfer gear.

Table 2. Oil Specifications (250 psi Spring)

LIMITS FOR MARINE TRANSMISSION EQUIPPED WITH A CONTROL VALVE SET AT 1724 kPa (250 psi)													
INPUT RPM & SHIFT		VALVE INLET			PRIMARY		SECONDARY		LUBE			Cooling Temp. * °C °F
		MIN. kPa (psi)	ACT kPa psi	MAX. kPa (psi)	MIN kPa (psi)	ACT kPa psi	MIN. kPa (psi)	ACT kPa psi	MIN kPa (psi)	ACT kPa psi	MAX kPa (psi)	
1800	Primary	1724 (250)		1827 (265)	1586 (230)		0 (0)		48 (7)		117 (17)	
	Neutral	1724 (250)		1827 (265)	0 (0)		0 (0)		55 (8)		124 (18)	
	Secondary	1724 (250)		1827 (265)	0 (0)		1586 (230)		48 (7)		117 (17)	
600	Primary	1689 (245)		1758 (255)	1551 (225)		0 (0)		11 (1.6)		19 (2.8)	
	Neutral	1689 (245)		1758 (255)	0 (0)		0 (0)		11 (1.6)		24 (3.5)	
	Secondary	1689 (245)		1758 (255)	0 (0)		1551 (225)		11 (1.6)		19 (2.8)	

Note: It is required that lube pressure with primary clutch engaged must equal lube pressure with secondary clutch engaged within 21 kPa (3 psi).

Note: Oil temperature to be in normal operating range of 66° - 85° C (150° - 185° F).

Optional Equipment

The following optional equipment for use with the model MGX-5114A is available through the nearest authorized Twin Disc distributor.

Power Take-off

A live power take-off pump mount is available in sizes SAE J-744 No. 127-4 and SAE J744 No. 32-4 (PX9768).

A clutchable pump mount power take-off is available in sizes SAE J-744 No. 127-4 and SAE J744 No. 32-4 (XA7553A).

A clutchable shaft drive power take-off is available (XA7553).

PTO adapter from SAE J-744 size 127-4 to 101-2 (XB2403).

Mounting Brackets

Steel fabricated mounting brackets for rigid mounting are available. They are part number 1016428-P.

Torsional Input Coupling

Several models of torsional input couplings are available, including Vulkan VKE4010 and VKE4011 in both 14” and 11.5” flywheel sizes as well as Centa CF-R in both 14” and 11.5” flywheel sizes.

Heat Exchanger

PM10685A heat exchanger is available, shipped loose as KS629 or mounted as KS452.

Companion Flange Assembly

The XB-5917 companion flange assembly consists of the companion flange and nuts and bolts.

Electric Control Valve

The GP Electric Control Valve and proportional valves are standard on the MGX5114A, and can be controlled with either 12 VDC or 24 VDC input power.

Trolling Valve

The e-troll controller is available for the MGX5114A, and includes input and output speed pickups mounted on the transmission.

Assembly Specifications

Table 3. Gear Advance Specifications

Primary Transfer Gear Advance		
Minimum 4.11 mm (.162 in)	Actual	Maximum 5.79 mm (.228 in)
Secondary Transfer Gear Advance		
Minimum 4.11 mm (.162 in)	Actual	Maximum 5.79 mm (.228 in)
Output Gear Advance		
Minimum 2.24 mm (.088 in)	Actual	Maximum 3.05 mm (.120 in)

Table 4. Bearing Preload (End Play) Specifications

Tapered Roller Bearing Preload				
	Minimum	Actual	Maximum	Total Shim
PRIMARY	-.05 mm (-.002 in)		-0.10 mm (-.004 in)	
SECONDARY	-.05 mm (-.002 in)		-0.10 mm (-.004 in)	
INTERMEDIATE, MGX-5114IV only	-.05 mm (-.002 in)		-0.10 mm (-.004 in)	
OUTPUT	-.05 mm (-.002 in)		-0.10 mm (-.004 in)	
Note: All endplay specs are negative (preload)				

Table 5. Clutch Specifications

Note: See Special Tools Section for Bench Test Fixture and Calibration Instructions.

Sequence Valve Cracking Pressure			
Shaft	Minimum	Actual	Maximum
Primary	1310 kPa (190 psi)		1448 kPa (210 psi)
Secondary	1310 kPa (190 psi)		1448 kPa (210 psi)

Clutch Clearance			
Shaft	Minimum	Actual	Maximum
Primary	2.3 mm (.091 in)		4.0 mm (.157 in)
Secondary	2.3 mm (.091 in)		4.0 mm (.157 in)

Torque Values for Fasteners

Note: All threads and bearing face to be lubricated with light oil film prior to assembly. Use SAE Grade 5 and Property Class 8.8 torque values for all screws that are threaded into aluminum.

Table 6. U.S. Standard Fine and Coarse Thread Capscrews, Bolts, and Nuts

Thread Diameter	SAE Grade 5		SAE Grade 8	
	lb-ft	Nm	lb-ft	Nm
1/4	6 - 8	8 - 11	10 - 12	14 - 16
5/16	13 - 17	18 - 23	20 - 24	27 - 32
3/8	25 - 29	34 - 39	35 - 41	48 - 55
7/16	37 - 43	51 - 58	55 - 65	75 - 88
1/2	60 - 70	81 - 95	83 - 97	113 - 131
9/16	82 - 98	111 - 132	120 - 140	163 - 190
5/8	120 - 140	163 - 190	165 - 195	224 - 264
3/4	205 - 245	278 - 332	295 - 345	400 - 467
7/8	330 - 390	448 - 528	470 - 550	638 - 745
1	495 - 585	671 - 793	715 - 835	970 - 1132
1 1/8	615 - 735	834 - 997	1015 - 1185	1377 - 1606
1 1/4	850 - 1000	1163 - 1355	1375 - 1625	1865 - 2203

Table 7. Metric Coarse Thread Capscrews, Bolts, and Nuts

Thread Size	Property Class 8.8		Property Class 10.9		Property Class 12.9	
	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm
M6	6.5 - 7.5	9 - 10	9 - 10	12 - 14	10 - 12	14 - 16
M8	16 - 18	21 - 25	23 - 26	31 - 35	25 - 29	34 - 40
M10	32 - 36	43 - 49	44 - 51	60 - 68	51 - 59	70 - 80
M12	55 - 63	74 - 86	77 - 88	104 - 120	89 - 103	121 - 139
M16	132 - 151	179 - 205	189 - 217	256 - 294	219 - 253	298 - 342
M20	257 - 295	348 - 400	364 - 418	493 - 567	429 - 493	581 - 669
M24	445 - 511	603 - 693	626 - 720	848 - 976	737 - 848	1000 - 1150
M30	714 - 820	987 - 1113	1235 - 1421	1674 - 1926	1475 - 1697	2000 - 2301

Table 8. Tapered Pipe Plugs (with thread lubricant)

NPTF Size (in)	In Steel or Cast Iron		In Aluminum	
	Nm (+ or - 5 %)	lb-ft (+ or - 5 %)	Nm (+ or - 5 %)	lf-ft (+ or - 5 %)
1/16-27	11.5	8.5	7.5	5.5
1/8-27	14	10.5	9	6.5
1/4-18	34	25	22	16
3/8-18	37	27	23	17
1/2-14	68	50	41	30
3/4-14	73	54	46	34
1 -11 1/2	108	80	68	50
1 1/4 - 11 1/2	115	85	75	55
1 1/2 - 11 1/2	115	85	75	55

Table 9. Straight Threaded Tube Fittings, Hose Fittings, and O-ring Plugs

Nominal Thread Diameter	Nm + or - 5 %	lb-ft + or - 5 %	Nominal Thread Diameter	Nm + or - 5 %	lb-ft + or - 5 %
5/16	5	3.5	1 5/8	108	80
3/8	11.5	8.5	1 7/8	108	80
7/16	16	12	2 1/2	108	80
1/2	20	15	M10X1.0	12	9
9/16	24	18	M12X1.5	16	12
5/8	24	18	M14X1.5	20	15
11/16	34	25	M16X1.5	24	18
7/8	54	40	M18X1.5	34	25
1 1/16	75	55	M22X1.5	54	40
1 3/16	88	65	M27X2.0	75	55
1 1/4	88	65	M33X2.0	88	65
1 5/16	108	80	M42X2.0	108	80
1 3/8	108	80	M48X2.0	108	80

Operation

General

The GP Control Valve with its Electronic Interface is used to obtain neutral and primary clutch engagement, and secondary clutch engagement in this transmission. When these positions are selected, the control valve directs high-pressure oil through internal passages to instantaneously and smoothly engage the clutches. The pressure-rate of rise, controlled by the Profile Generator, provides a rapid, smooth, clutch engagement.

General Overview of GP Control Valve with Electronic Interface

The General Purpose (GP) control valve is a hydraulic valve assembly for use with Twin Disc Marine Transmissions, that may include an integral electronic interface control module. The valve assembly contains current controlled proportional cartridges.

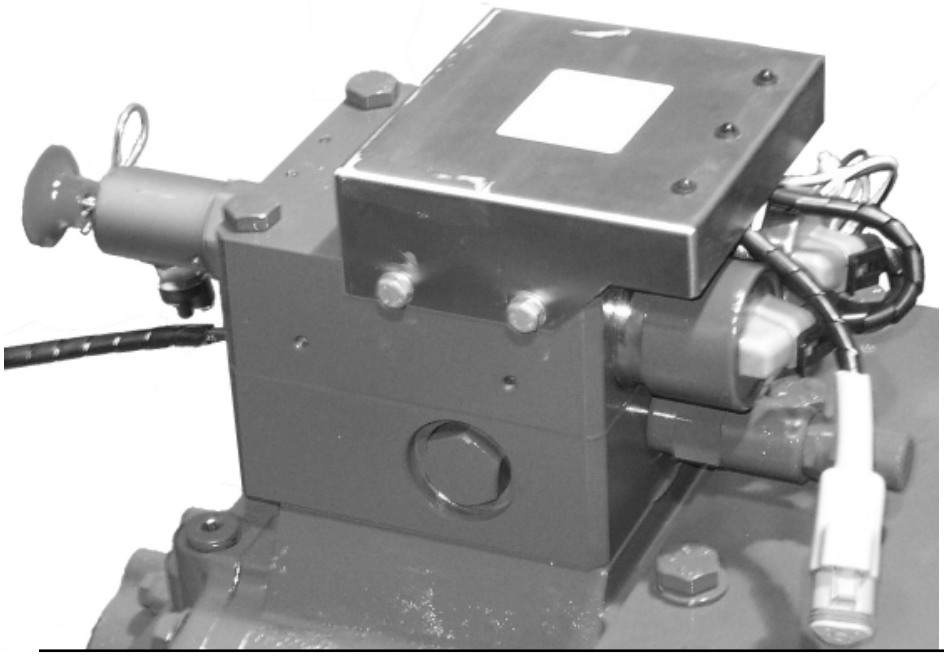


Figure 2. GP Valve Assembly mounted on Marine Transmission.

GP Control Valve Hydraulic Portion

The hydraulic portion of the GP Control Valve is made up of two blocks, a lower main regulator valve body, and an upper valve body. The upper valve body contains two electrically actuated proportional valves, and a manual direction control cartridge valve. The lower valve body contains the hydraulic pressure regulating valve and a temperature sensor if the application requires it. There are two different versions of the lower valve assembly. The hydraulic pressure regulating valve in earlier versions (Assembly 1020729) consist of two cartridge assemblies, a pilot relief cartridge assembly and a main spool cartridge assembly. The hydraulic pressure regulating valve in later versions (Assembly 1021658) is not a cartridge assembly, but is comprised of a spring and spool, with an adjustment cover. The regulating valve body contains a ball check valve assembly in parallel with an orifice with a filter that provides rapid fill and damping for the rear cavity of the regulator valve. A kit is available to upgrade the earlier version to the later version. The manual direction control cartridge valve contains a switch that is closed when the valve is in the neutral position. Separate identical proportional cartridges are used for the primary and secondary clutch actuation. When the primary or secondary clutch is selected by the operator, the control valve directs high-pressure oil through internal passages to operate the clutches. The pressure-rate of rise (profile) is controlled electronically by the GP Control Valve Electronic Interface (Profile or E-Troll Module) to provide a rapid, smooth, oil pressure increase in the clutch hydraulic passages during engagement.

⚠CAUTION

The proportional valve coils are low resistance devices that are current driven. The use of an uncontrolled power source may supply too much current and damage the proportional valve.

Note: Installations with this valve must include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better. Besides the valve's requirement on filtration, the filter must meet the requirements of the transmission (operating pressure, flow, etc.)

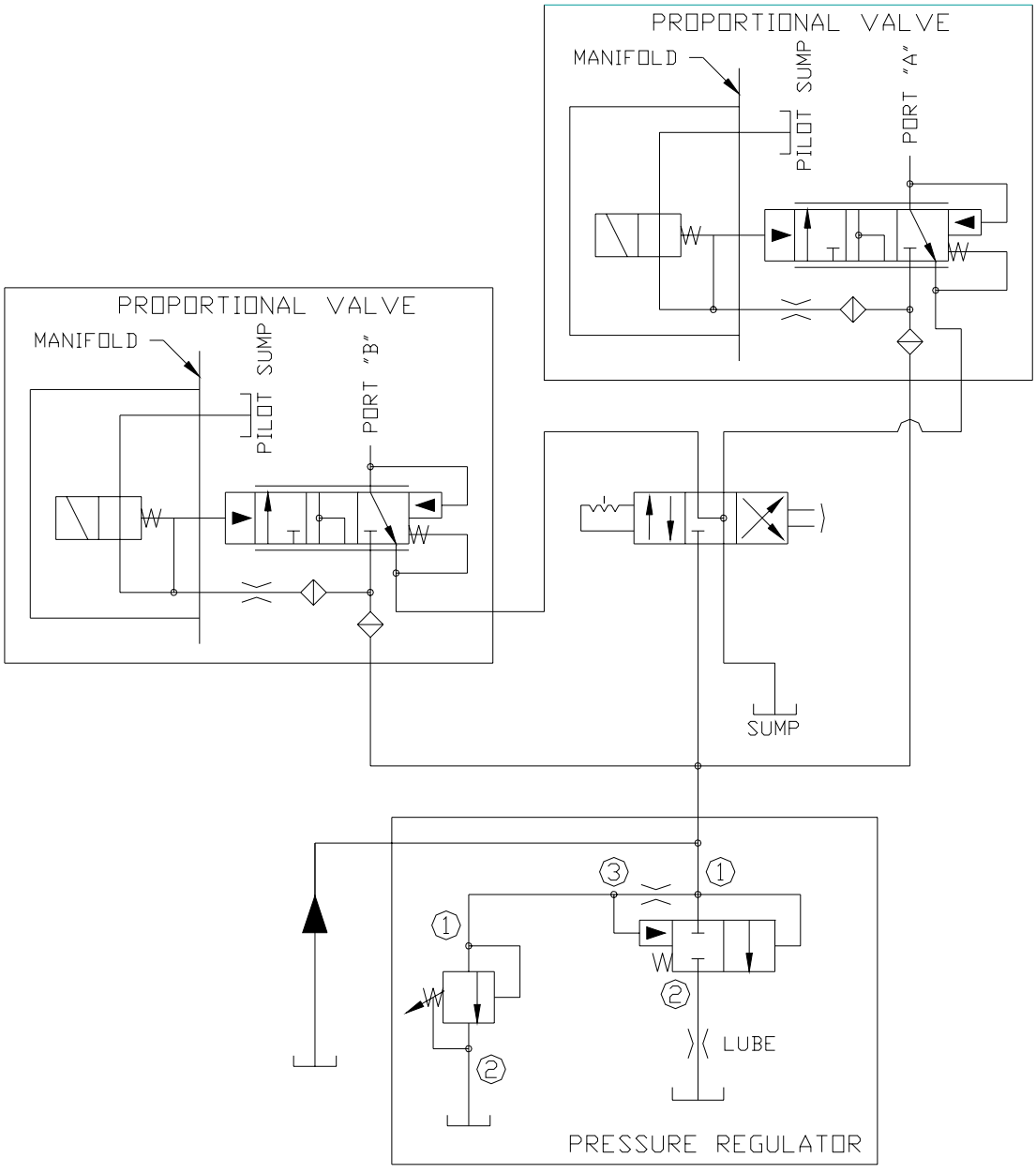


Figure 3. Hydraulic Schematic (GP control valve)- Assembly 1020729

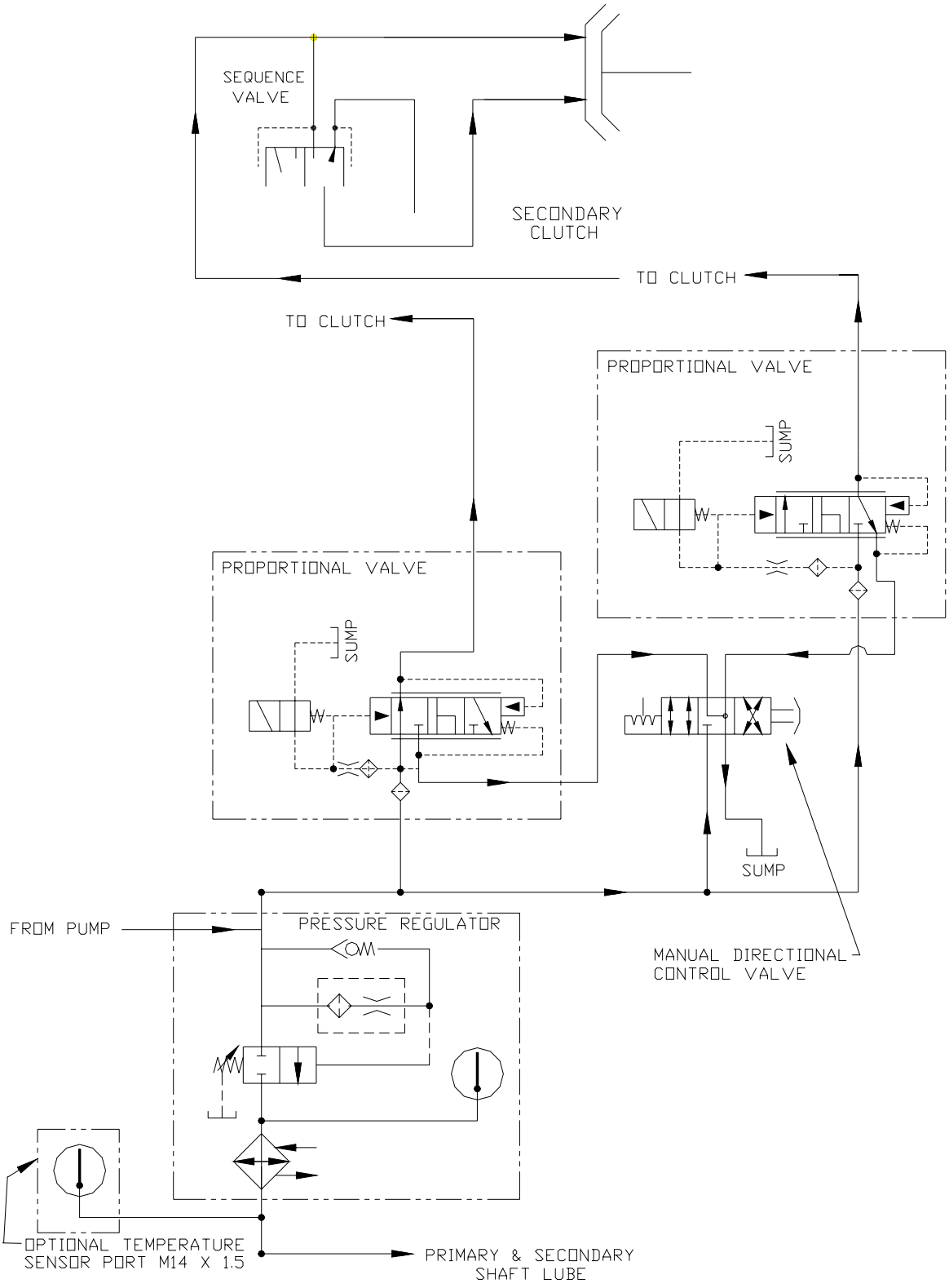


Figure 4. Hydraulic Schematic (GP control valve) -- Assy 1021658

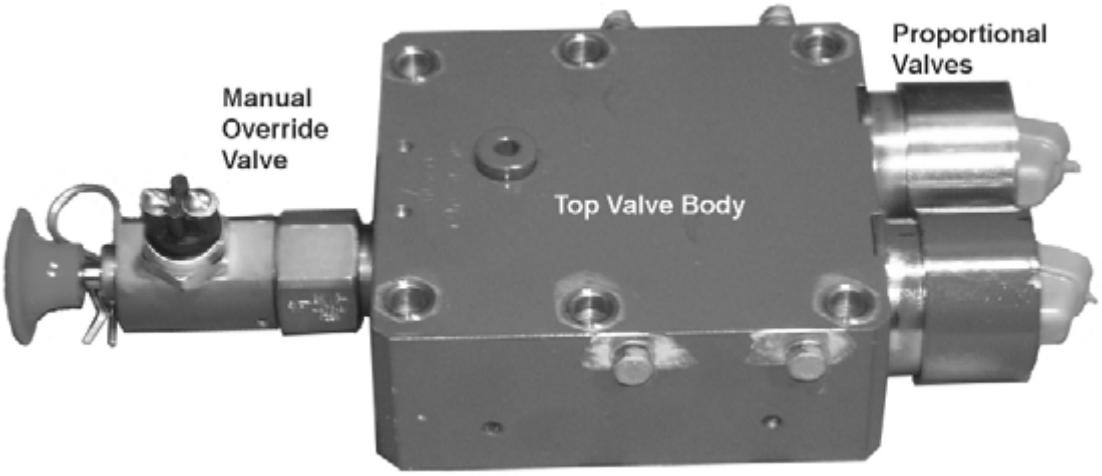


Figure 5. Top Hydraulic Valve Body Assembly

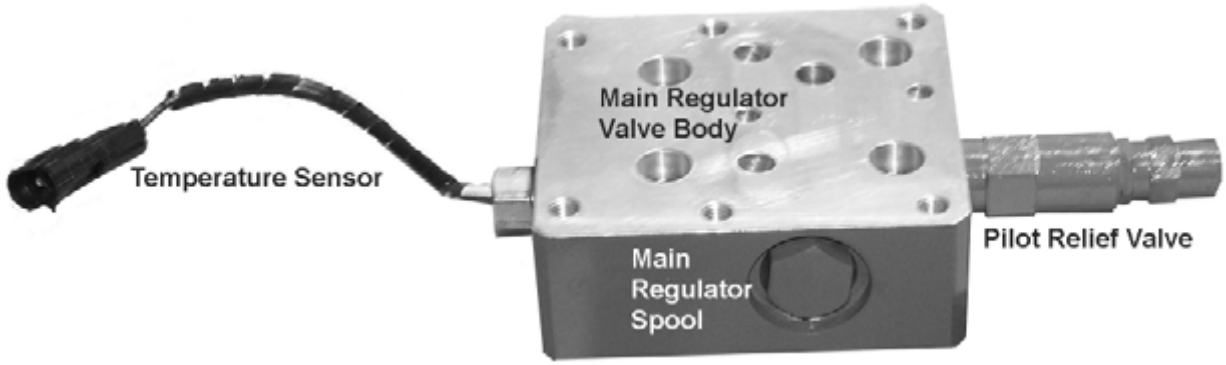


Figure 6. Main Regulator Hydraulic Valve Assembly (1020729)

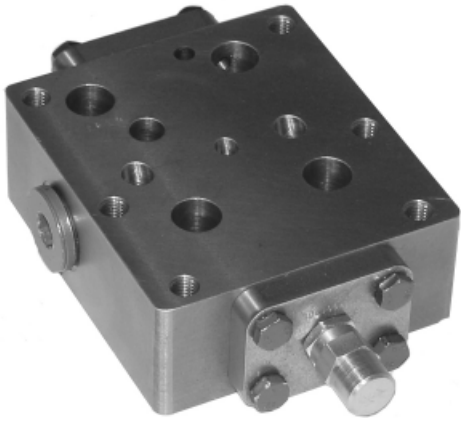


Figure 7. Main Regulator Assembly (1021658)

GP Control Valve Electronic Control Interface (Profile or E-Troll Module)

Note: Some installations will consist of the hydraulic portion of this valve, and the Electronic Control Interface will be replaced by an appropriate electronic control system.

The electronic portion of the GP Control Valve fastens to the hydraulic portion of the GP Control Valve, and is located on the top surface.

⚠WARNING

If the ambient temperature of this mounting location exceeds 180°F, the Electronic Control Interface must be relocated to a cooler area. Contact Twin Disc for proper harnessing instructions.

This module contains the electronic circuitry to control the proportional cartridges that are used to engage the clutches based on the commands from the operator. Clutch apply pressure rate of rise (profile) is factory set with the use of internal circuitry. The initial fill level is factory set with an adjustment screw that is embedded in the bottom surface of the Profile or E-Troll Module, and sealed. This can be field adjusted if necessary by authorized personnel with the proper instrumentation. There are different control module types for Quickshift marine transmissions (MGX), both with and without the trolling (E-Troll) feature. All electrical wiring for the marine transmission system controls are routed through this interface module. The vessel battery power (12 vdc or 24 vdc) is supplied to the electronic interface only, and never directly to the hydraulic proportional valves. Two red led lights are used to identify the proportional cartridge valve that is energized, and a green led is used to identify when power is provided to energize one of the clutches. Flashing lights are used in troubleshooting. Signals are provided to power a customer supplied relay to allow engine starting only when in neutral. A Transmission oil temperature sensor is not required for the Quickshift marine transmission (MGX) models. Engine speed and Propeller speed sensors are required for transmissions with E-Troll. The following figures show the various versions of Electronic Profile or E-Troll Module.

⚠WARNING

Do not connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

Figure 8. Electronic Profile Module (MGX non-troll)

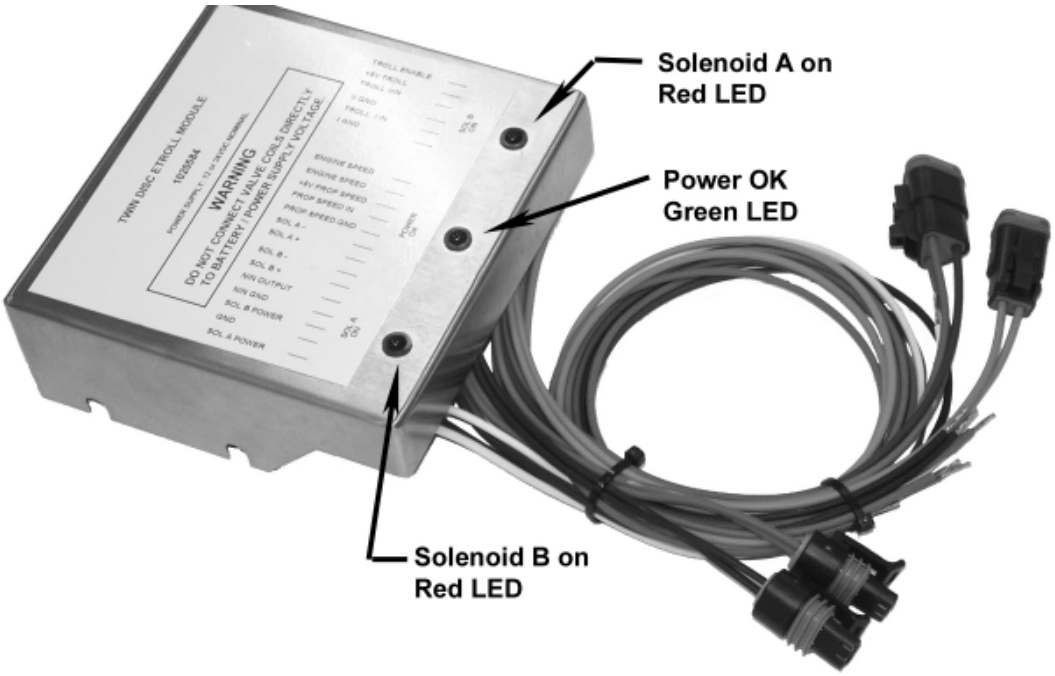


Figure 9. Electronic E-Troll Module (MGX E-Troll)

Hydraulic System with GP Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the heat exchanger to the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil (Assembly 1020729) is supplied to the main pressure regulating relief pilot cartridge and the main regulating valve cartridge, satisfying the main pressure requirements of the transmission, cascading all remaining oil flow into the lubrication circuit. The incoming oil (Assembly 1021658) is supplied to the main pressure regulating valve and is supplied in parallel paths through a ball check valve and an orifice with filter to quickly regulate, and dampen pressure oscillations, satisfying the main pressure requirements of the transmission, cascading all remaining oil flow into the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings.

Main pressure is supplied to the inlet of each proportional valve, and to the inlet of the manual direction control valve. In Neutral, the inlet port of both clutches is connected to the sump. Since the area behind the clutch pistons is open to sump, the clutches are disengaged.

When one of the clutches is commanded to engage, the proportional valve directs main pressure to a passage in the clutch shaft. The oil is directed to a small area chamber behind the clutch apply piston, and also against the sequence (“S”) valve that is located in the clutch shaft. The pressure on the small area of the clutch apply piston quickly moves the piston to engage the clutch at a low capacity level. The pressure rises until the “S” valve opens, allowing the high pressure oil to be supplied to the large area of the clutch apply piston, providing a rapid increase in the clutch capacity. The rate-of-rise is controlled electronically and prefills the engaging clutch at a predetermined level, and then increases to full pressure, following a predetermined timing sequence. The initial prefill level is factory adjustable by means of an adjustment screw embedded in the bottom surface of the electronic interface. Field adjustment of this feature should never be attempted without special equipment and knowledge of its use to prevent serious mechanical damage to the marine transmission or vessel.

Clutch release occurs when the proportional valve is de-energized, and the oil from the small area of the clutch apply piston is allowed to flow to sump through the control valve, and the oil from the large area of the clutch apply piston is allowed to flow to sump through a dump ball in the clutch housing, and through the “S” valve through a passage in the shaft into the transmission sump.

The electronic interface portion of the control valve allows only one proportional valve to be energized at a time, thus, only one clutch can be engaged at a time,

and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Note: Installations with this valve include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better.

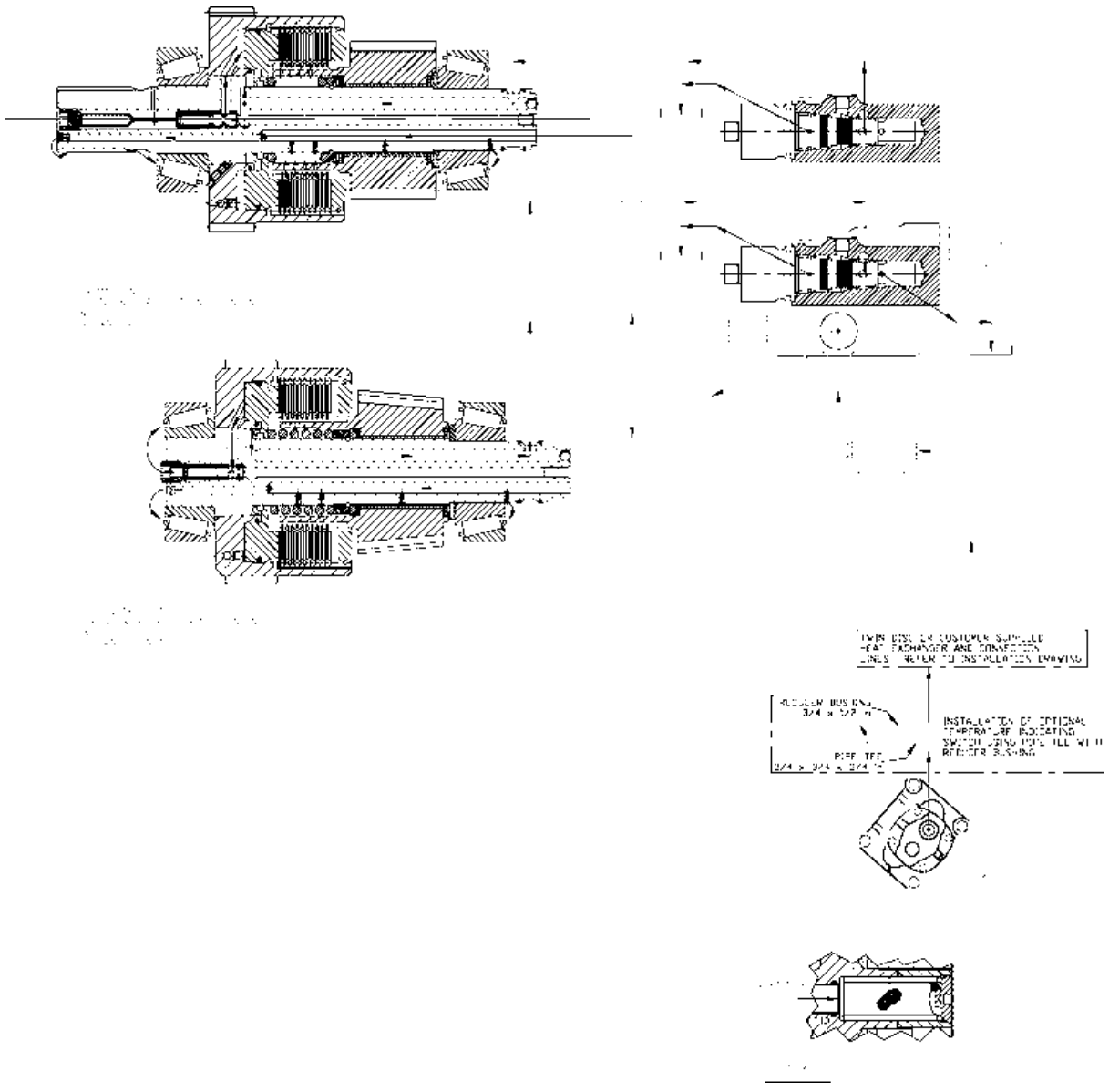


Figure 10. Hydraulic Schematic (MGX5114A)

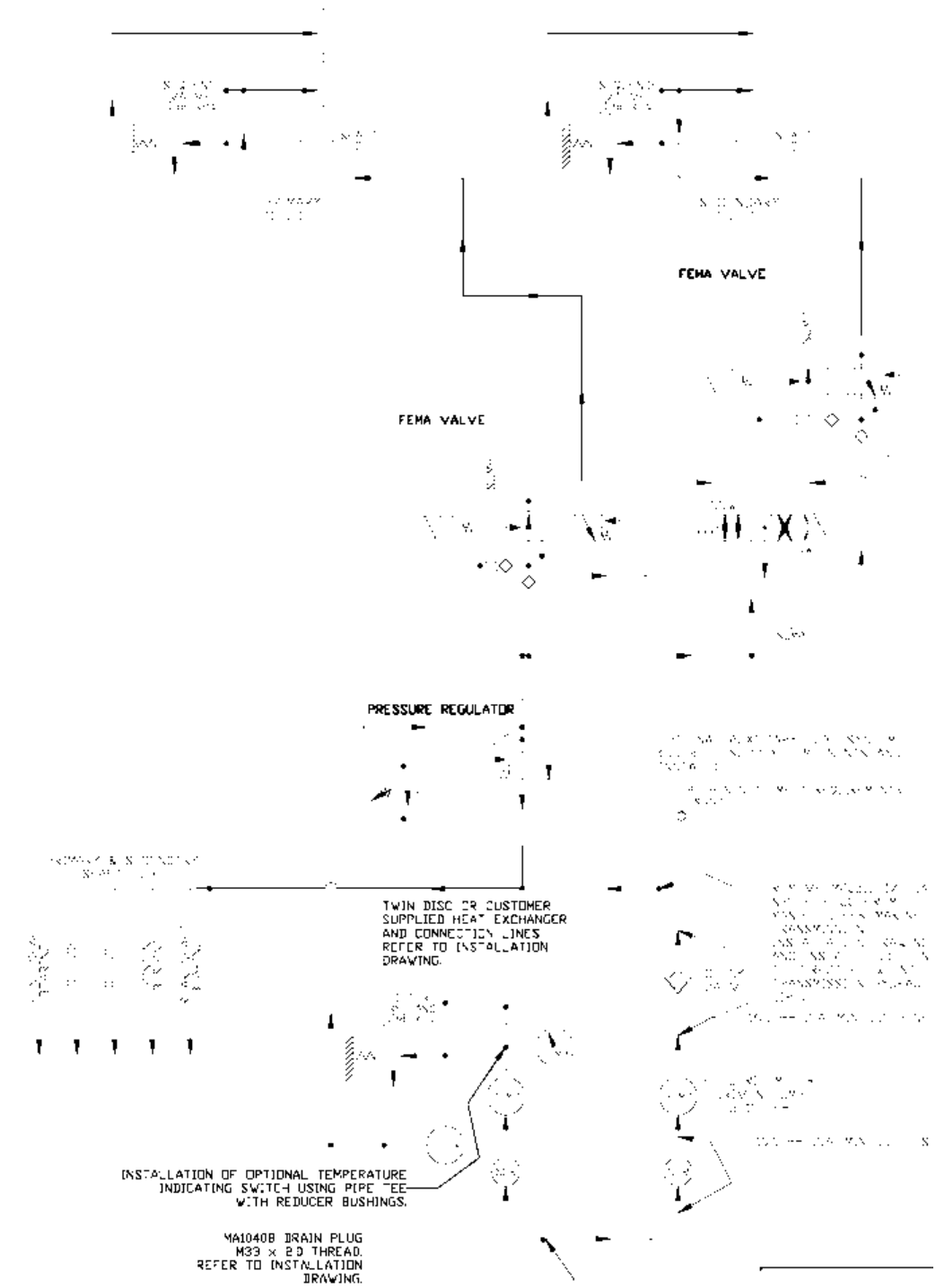

FEMA VALVE
FEMA VALVE
PRESSURE REGULATOR
TWIN DISC OR CUSTOMER SUPPLIED HEAT EXCHANGER AND CONNECTION LINES REFER TO INSTALLATION DRAWING.
INSTALLATION OF OPTIONAL TEMPERATURE INDICATING SWITCH USING PIPE TEE WITH REDUCER BUSHINGS.
MA1040B DRAIN PLUG M33 x 2.0 THREAD. REFER TO INSTALLATION DRAWING.

Figure 11. Hydraulic Schematic (MGX5114A) JIC Symbols

Manual Direction Control Valve Operation

The manual direction control valve is locked in the NEUTRAL (center) position during normal operation. There are three possible positions of the manual direction control valve stem. If conditions exist that the operator wishes to manually operate the transmission for any reason, the operator can remove the locking pin from the direction control valve, and push the stem into the valve for the engagement of clutch A, or pull it out of the valve for the engagement of clutch B. The manual direction control valve has an integral switch with contacts that are closed only when the manual direction control valve is in the NEUTRAL position. This switch must be wired such that the engine cannot be started while clutch A or clutch B is engaged.

CAUTION

Engagement of a clutch with the Manual Direction Control Valve should only be done with the engine at idle speed.

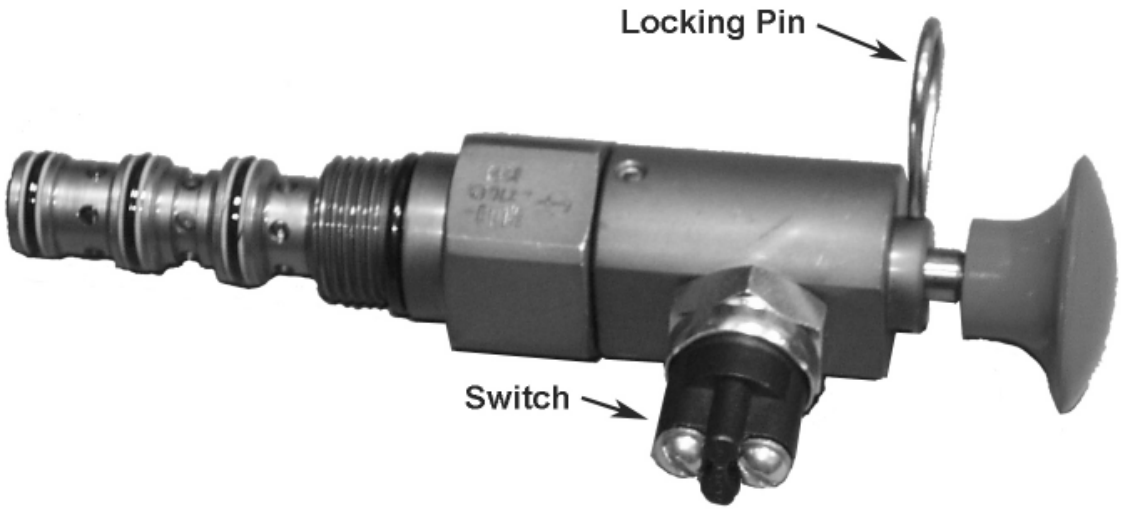


Figure 12. Manual Direction Control Valve

Power Take-offs (Optional)

There is a separate manual (part number 1020075) which describes the operation, installation, troubleshooting, and service of the optional Power Take-offs (PTO's) for this marine transmission.

Live Power Take-off

The live PTO drives accessories using engine horsepower. Since the live PTO connects the accessory to the primary shaft of the transmission via a direct coupling, the accessory is driven whenever the engine is running.

Power Flow

Input power to the transmission is through a torsional coupling mounted on the engine flywheel. The coupling is splined to the forward end of the primary (forward clutch) shaft causing the primary shaft to rotate in engine direction during engine operation. Power is transmitted to the secondary shaft by means of the transfer gear teeth on the outer diameter of the primary clutch housing. These teeth are in constant mesh with gear teeth on the of the secondary clutch housing causing the secondary shaft to rotate in anti-engine direction. The primary and secondary pinions on their respective shafts are in constant mesh with the output gear, which is connected to the output shaft through a keyless tapered joint.

Application of the primary clutch locks the primary pinion to the primary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in anti-engine direction. Application of the secondary clutch locks the secondary pinion to the secondary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in engine direction.

Note: The following power flow illustrations are shown merely as examples of power flow and may not pertain specifically to your unit.

Neutral

When in neutral the primary and secondary shafts, transfer gears and clutch friction plates rotate at engine speed.

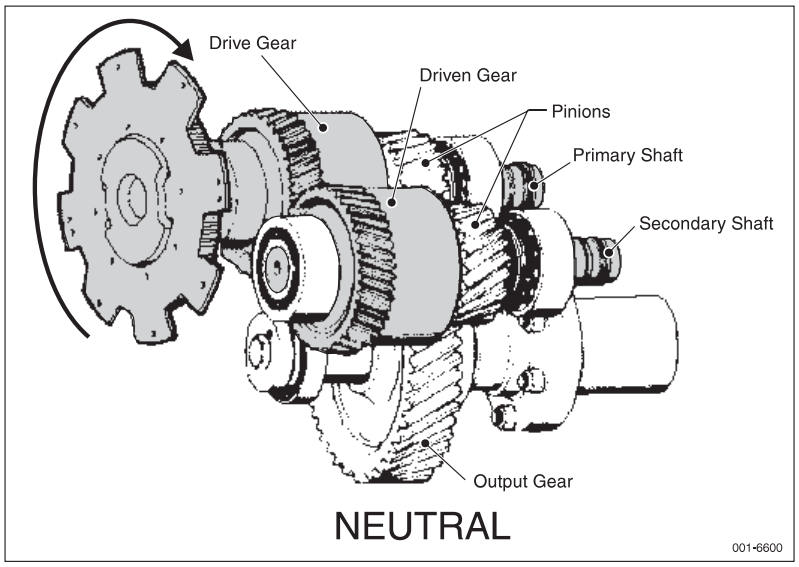


Figure 13. Example of Power Flow in Neutral

Primary

When the primary position is selected, hydraulic pressure is applied to the primary clutch piston clamping the friction and steel clutch plates together. The primary input pinion will then rotate at engine speed and direction because the steel plates are spline-connected through the clutch hub assembly to the pinion. Because the primary input pinion is in mesh with the output gear, the output gear and shaft will rotate in anti-engine direction. The secondary input pinion will be backdriven (engine direction) when the unit is in the primary position.

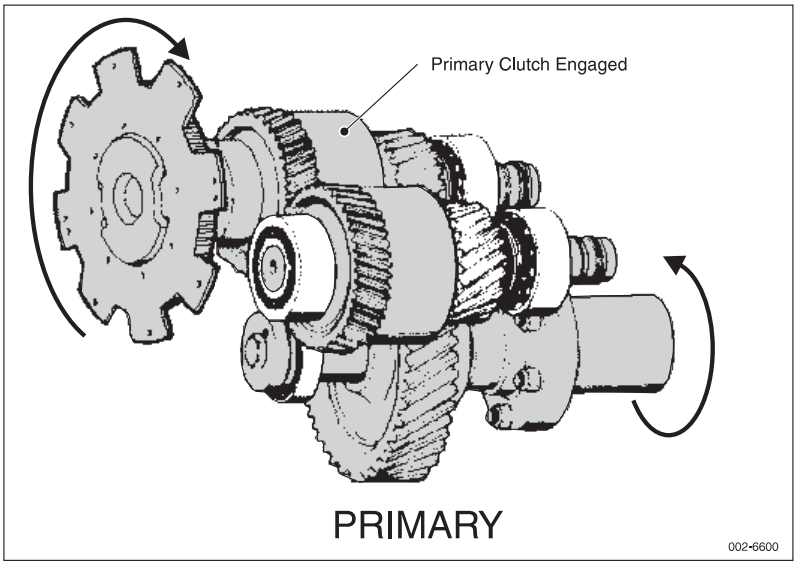


Figure 14. Example of Power Flow with Primary Clutch Engaged

Secondary

In secondary, the same parts are turning that were turning in neutral. When the secondary position is selected, hydraulic pressure is applied to the secondary clutch piston clamping the friction and steel plates together. The secondary input pinion will then rotate at engine speed and anti-engine direction, because the steel clutch plates are spline connected through the clutch hub assembly to the input pinion. Because the secondary input pinion is in mesh with the output gear, the output gear and shaft will rotate in engine direction. The primary input pinion will be backdriven (anti-engine direction) when the unit is in the secondary position.

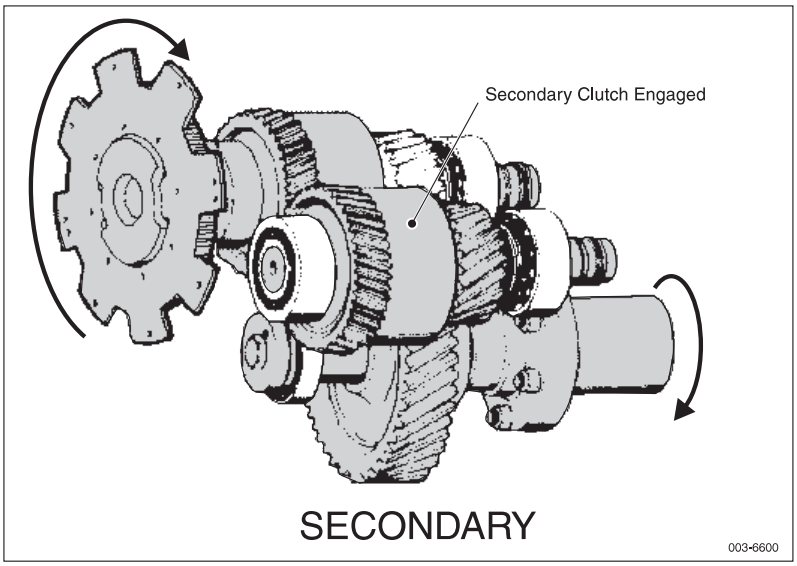


Figure 15. Example of Power Flow with Secondary Clutch Engaged

Preventative Maintenance

In-boat Maintenance and Repair

Certain transmission maintenance/repair procedures can be accomplished in the boat provided sufficient space exists to work. These procedures are:

- ❑ Removing and installing the oil pump.
- ❑ Changing the filter.
- ❑ Removing, cleaning and installing the suction strainer.
- ❑ Removing and installing the control valve.
- ❑ Removing and installing the manifold.

Note: Further disassembly/reassembly of the primary or secondary shafts will require removal from the engine, and the use of tools and equipment normally not available on board the vessel.

General Maintenance

Overhaul Interval

A complete overhaul and thorough inspection of the unit should be made at the same time as the scheduled engine overhaul. Refer to Cleaning and Inspection for more detailed inspection instructions.

Oil System

Oil Level

The oil level should be checked daily or every 10 hours. Check oil level before starting the engine to confirm that the transmission has oil in it. With the engine running at low idle and the transmission in Neutral, check the oil again. The oil level should be near the “low” oil level mark. Transmission oil temperature should be in the normal operating range prior to finalizing the oil level between the low and full marks on the oil level gauge.

Oil and Filter Change Interval (Maximum)

Note: A suction screen is located in the suction line to the pump, and the oil filter is located in the pump outlet line. Both should be checked and cleaned at the stated intervals.

With a new transmission, change the oil and filter element and clean the suction strainer (screen) within the first 50 hours of operation. Change oil and filter element and clean the screen after each 1000 hours thereafter or more often if conditions warrant.

For a rebuilt transmission, check the filter element (and suction screen) after eight hours of operation. If the filter and screen are clean, install a new filter element and then change the oil and filter element after 1000 hours of service. If the filter is dirty, change the element and operate for another eight hours. Check the filter again. Continue this cycle until the filter is clean and then change the oil and filter after 1000 hours of service or more often if conditions warrant.

Draining

Drain the transmission by removing the O-ring plug at the rear side at the bottom.

Oil Suction Strainer

Remove and clean the pump suction strainer at every oil change or sooner if necessary. The suction strainer is located in the manifold below the pump. See Engineering Drawings for suction strainer location. (See discussion under oil change interval.)

Type Oil Recommended

See Description and Specifications.

Filling

1. Remove the filler breather in the top of the transmission.

2. Fill the transmission's sump with the proper weight and type oil. See Description and Specifications for oil recommendations.

3. Start the engine and let it idle with transmission in neutral until oil is circulated throughout the hydraulic system. Add oil if necessary to bring the oil level up to the "low" mark with the engine at low idle.

4. With the oil at operating temperature, transmission in neutral, and the engine running at low idle, check the oil level with the oil gauge. Add or remove oil if necessary to bring the oil level to "FULL" mark on the oil gauge. Allow the oil temperature to cool to normal cold oil conditions (perhaps overnight). Check the oil level while cold at low idle engine speed while in neutral. This is the proper oil level with cold oil. Make note of this correct oil level in cold conditions for future reference.

Periodic Visual Inspection

General

- ❑ Check the mountings for tightness or damage such as cracks. Tighten loose mountings and replace damaged parts.
- ❑ Check pressure and temperature gauge where applicable.
- ❑ Periodically, inspect the drive line and the input and output shaft oil seals for leakage. Replace parts as required.
- ❑ Inspect unit nameplates for looseness and corrosion. Tighten mounting screws that are loose and replace nameplates that are corroded.
- ❑ Inspect and oil the exposed stem of the Manual Direction Control Valve for corrosion protection.

Torsional Coupling

Do not obstruct the flywheel housing vents preventing the free flow of air for cooling the coupling. The ambient temperature of the air around the coupling should be between -6˚C (22˚F) and 80˚C (176˚F). Assure baffles are installed properly so hot air is ported out of the housing.

Visually inspect the element after the first 100 hours of operation and every 2000 hours thereafter, or every six months, whichever comes first. Torsional vibration, misalignment, degradation by contaminants (oil), heat, ultraviolet radiation, and excessive system torque can cause cracks or other signs of distress to appear on the surface of the rubber. The above-described items affect the life of the coupling element. Perform a complete inspection whenever the transmission is removed from the engine for any reason.

When inspecting the flexible coupling, look for evidence or conditions identified in the following steps:

- ❑ Cracks in the surface of the rubber. May be caused by torsional vibrations, excessive misalignment or exposure to contaminants (heat, petroleum products, chemicals, ozone, ultraviolet radiation, etc.) excessive system torques.
- ❑ Separation of rubber from flex plate on coupling plate or deterioration of the rubber-to-metal bond. See above.

- ❑ Deterioration of the rubber element, as evidenced by sponginess or by black carbon-like dust on rubber surface may be caused by contaminants or excessive heat, either external or internal to the coupling.
- ❑ Cracked, bent or otherwise damaged flex plate or coupling plate.
- ❑ Bolt holes in flex plate or coupling plate elongated or deformed. This could be caused by improperly assembled parts, loose parts, vibration or improperly torqued parts.
- ❑ Bolts/nuts—bent, worn or stripped threads.

Inspect the hub, looking for the following:

- ❑ Damaged or worn splines.
- ❑ Cracked parts.
- ❑ Oil seal surface for wear or damage.

Replace any defective parts including defective fasteners that are found.

Heat Exchanger Check

Inspect heat exchanger oil lines for leaky connections, kinks, cracks or other damage. Replace damaged lines.

Heat exchangers furnished by Twin Disc to be used for salt water applications have zinc rods installed at the inlet and outlet heads. These rods must be checked every 90 days. If over 50% of the rod is disintegrated, it should be replaced to provide effective protection.

Excessive corrosion of the zinc rod indicates electrolytic action. A careful inspection should be made to determine if this action is caused by a short circuit or external grounded electric current. If these conditions do not exist, it is evident that the corrosion is due to local electrolysis. If rods are corroded with foreign materials, they should be cleaned with a wire brush.

Troubleshooting

Troubleshooting of GP Control Valve with Electronic Interface

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Electronic Interface LED Indicators

The electronic interface control modules have one green and two red LED indicator lights. The green power light is illuminated only when the transmission is in gear.

The following table lists the reasons for the various conditions where lights are illuminated. This should guide in troubleshooting problems. See the wiring schematics in the Installation Section.
Troubleshooting Tables begin on the next page.

Table 10. LED Light Status

Light Status	Profile Generator (Non trolling)	E-troll Module
Green light on	Supply Voltage > 9.0 Volts	Supply Voltage > 9.0 Volts
Red light on	Valve coil commanded on	Valve coil commanded on
One red light flashing	Open circuit in an energized valve coil circuit	Open circuit in an energized valve coil circuit, or Valve coil leads shorted together, or Low coil current
Both red lights flashing simultaneously	Not applicable	After entering troll from neutral with both voltage and current troll signals present, or power is applied to Solenoid A and B switch inputs at the same time.
Both red lights flashing alternately	Not applicable	Either or both speed signals missing.

Table 11. Troubleshooting Chart --- GP Valve Equipped Transmissions

Symptom	Cause	Remedy
1. Low main oil pressure	1-1 Partially clogged oil strainer	1-1 Remove and clean oil strainer.
	1-2 Contamination on Pilot Relief Valve seat.	1-2 Disassemble the Pilot Relief Valve and clean. Service the transmission oil filter.
	1-3 Contamination in Main Valve Cartridge	1-3 Clean or replace the Main Valve Cartridge, and service the transmission oil filter.
	1-4 Broken piston rings on clutch shaft(s).	1-4 Remove the collector and inspect piston rings.
	1-5 Damaged or worn oil pump assembly.	1-5 Replace damaged or worn oil pump assembly (pump is not serviceable).
	1-6 Engine idle speed too low.	1-6 Raise engine speed.
2. No oil pressure, or erratic low pressure at control valve.	2-1 Oil pump suction strainer plugged.	2-1 Remove and clean strainer.
	2-2 Oil level low.	2-2 Check oil level and correct.
	2-3 Air leak on suction side of pump.	2-3 Correct cause of air leak.
	2-4 Pump drive on reverse clutch shaft broken.	2-4 Disassemble and repair as required.
	2-5 Pilot Relief Valve or Main Regulating Valve stuck in open position	2-6 Remove, disassemble, clean and repair the Pilot Relief Valve. Remove, clean, or replace the Main Regulating valve. This valve cannot be disassembled.
	2-6 Oil pump defective	2-7 Replace oil pump.
	2-7 Leaking heat exchanger has caused oil to be lost over board.	2-7 Replace heat exchanger

Table 12. Troubleshooting Chart (continued)--- GP Valve Equipped Transmissions

Symptom	Cause	Remedy
3. High main oil pressure.	3-1 Pilot Relief Valve out of adjustment..	3-1 Adjust the Pilot Relief Valve. Replace if necessary.
	3-2 Main Regulating Valve orifice missing.	3-2 Replace Main Regulating Valve Cartridge.
4. High temperature.	4-1 Improper oil level.	4-1 Check and fill (or drain) with proper oil to the correct level.
	4-2 Faulty heat exchanger	4-2 Inspect, repair, or replace heat exchanger.
	4-3 Clutches slipping	4-3 Check clutch apply oil pressure. If pressure is normal, remove, disassemble, and repair slipping clutch. If pressure is low, replace Proportional Valve, and service transmission oil filter.
	4-4 Bearing failure.	4-4 Overhaul marine transmission.
	4-5 Air leak on suction side of pump.	4-5 Inspect and correct cause of suction leak.
	4-6 Control valve malfunction	4-6 Inspect, repair, or replace control valve.
5. Excessive Noise	5-1 Bearing failure.	5-1 Overhaul marine transmission.
	5-2 Worn or damaged input coupling.	5-2 Remove marine transmission. Replace a worn or damaged coupling.
	5-3 Excessive torsional vibration.	5-3 Select proper torsional coupling.
	5-4 Worn or damaged gears.	5-4 Overhaul marine transmission.
	5-5 Improper alignment.	5-5 Check alignment of engine and transmission output flange to propeller shaft. Correct as necessary.
	5-6 Damaged propeller.	5-6 Repair propeller.
	5-7 Misfiring engine.	5-7 Repair engine.

Table 13. Troubleshooting Chart (continued)--- GP Valve Equipped Transmissions

Symptom	Cause	Remedy
6. No neutral.	6-1 Clutch plates warped.	6-1 Remove clutch plates. Overhaul unit.
	6-2 Disengaged clutch has apply pressure.	6-2 Replace Proportional Valve. Service transmission oil filter.
7. Harsh engagement or no engagement.	7-1 Faulty Proportional Valve.	7-1 Replace Proportional Valve.
	7-2 Faulty Temperature Sensor (if equipped).	7-2 Replace Temperature Sensor.
	7-3 Profile Generator defective or out of adjustment.	7-3 Replace Profile Generator. Adjust if proper equipment is available.
8. Low lube oil pressure.	8-1 Pump flow output too low.	8-1 Replace pump.
	8-1 Pump suction strainer plugged.	8-2 Remove, clean, inspect, and install the suction screen.
	8-3 Air leak on suction side of pump.	8-3 Inspect and correct cause of suction leaks.
	8-4 Lube relief valve malfunction.	8-4 Remove and clean or replace parts as necessary.
	8-5 Broken piston rings.	8-5 Replace damaged piston rings.
9. Oil spilling out of breather.	9-1 Oil level too high.	9-1 Adjust oil level.
	9-2 Wrong type of oil.	9-2 Draw and refill with recommended oil.
10. Low Clutch Apply Pressure	10-1 Low Main Pressure	10-1 See Paragraph 1.
	10-2 Defective Proportional Valve.	10-2 Replace Proportional Valve
	10-3 Low voltage to Profile Generator	10-3 Verify that green (voltage supply) light, and red (clutch energized) lights are bright

Disassembly

The following procedure is for complete disassembly of the unit. Prior to this procedure, the transmission should be removed from the boat. Qualified personnel should do the work in a fully equipped facility.

Prepare Transmission for Disassembly

Note: During service of this unit, all O-rings, gaskets and seals must be replaced. It is good practice to keep the old O-rings, gaskets and seals with the appropriate components being disassembled for future reference during the inspection and assembly process (to make sure you don't forget the quantity, size, etc.).

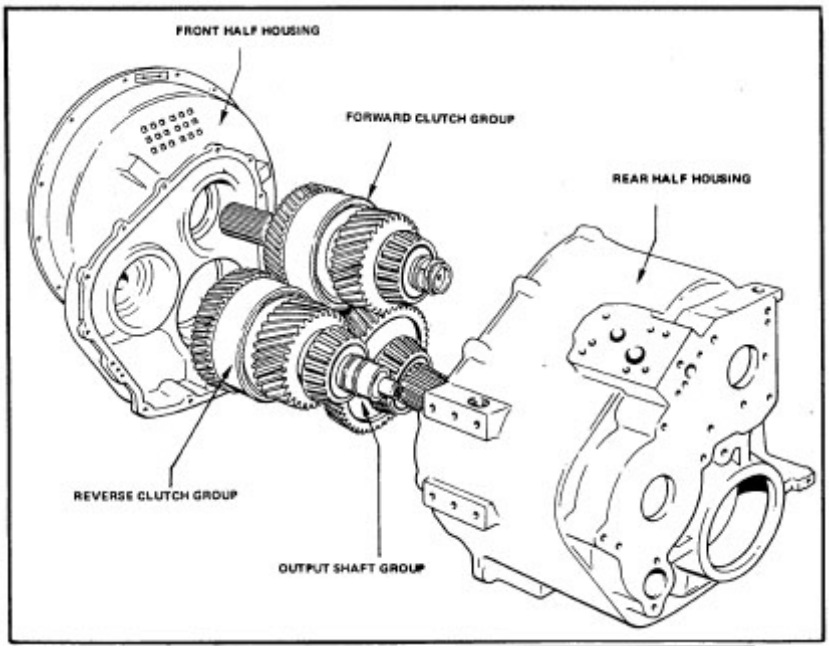


Figure 16. Relationship of Transmission Components

Prior to Removal

1. Drain the oil from transmission by removing the O-ring plug on the rear side at the bottom.

2. Mark the output flange and companion flange so they will always be assembled identically.

3. Disconnect the output and companion flanges.

4. Disconnect linkage, wiring, and plumbing and remove any items that would interfere with the removal of the transmission.

5. Support the transmission with a hoist and remove the mounting capscrews.

6. Support the rear of the engine with blocks if necessary.

7. Remove the 12 capscrews that secure the transmission to the engine.

8. Push the transmission away from the engine. Remove the transmission. Remove the input coupling from the engine flywheel.

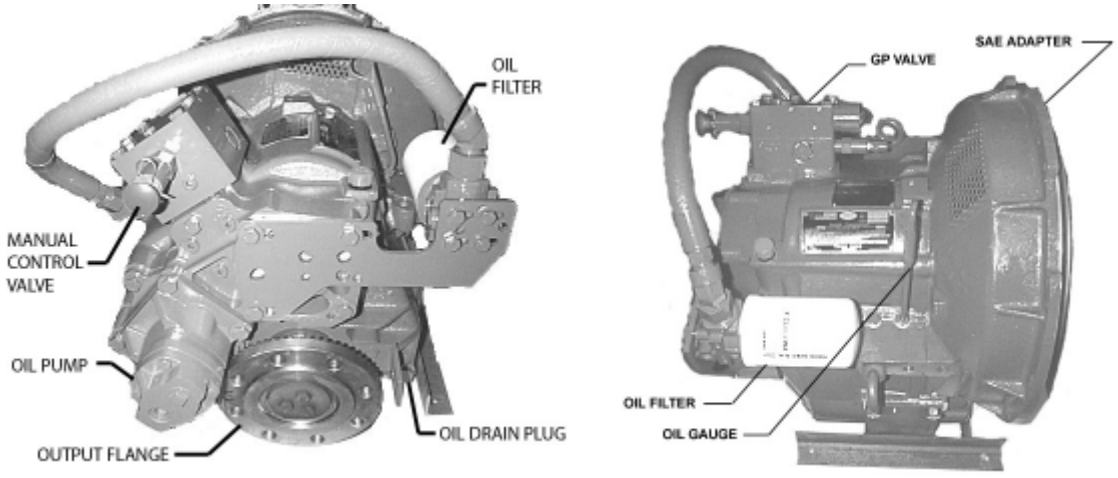


Figure 17. Marine Transmission Rear and Front View

Removal of External Parts

1. Remove the input coupling assembly from the input shaft.

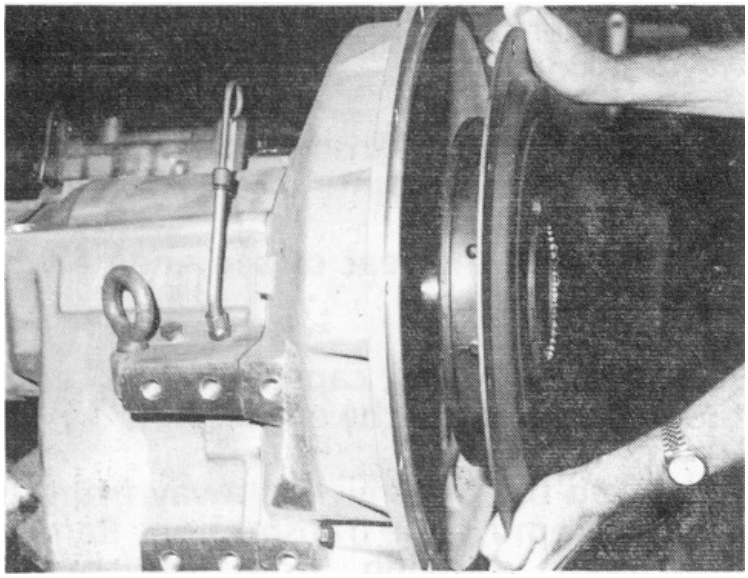


Figure 18. Removing Input Coupling

2. Remove the snap rings from the coupling hub and separate the hub from the coupling.

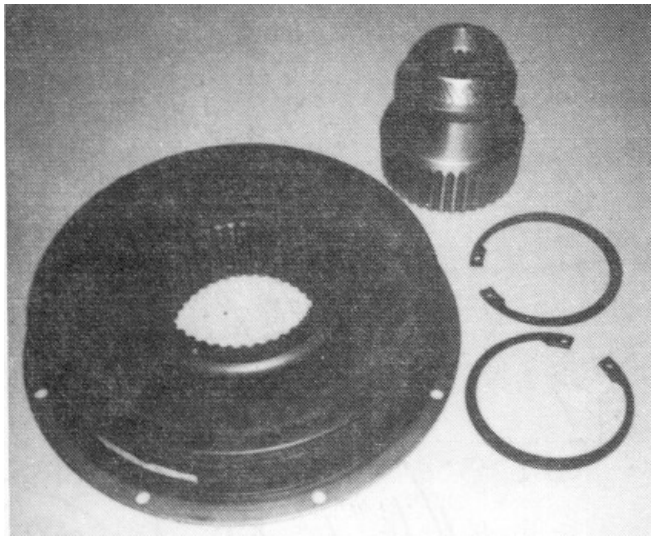


Figure 19. Coupling Hub Removed

⚠ CAUTION

The hydraulic pump can be installed two different ways; therefore, before removing the pump, place indexing marks on the pump and the manifold to insure correct installation. Do not remove the pump pipe plug. Do not disassemble pumps. They are not serviceable.

3. Remove the four capscrews securing the hydraulic pump to manifold assembly and remove the pump and gasket.

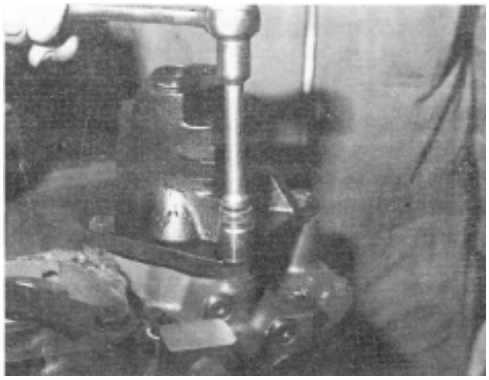


Figure 20. Removing Hydraulic Pump

4. Disconnect the wiring, and remove the electronic module and six capscrews that secure the GP valve top plate to the lower plate. Remove the gasket and four capscrews that retain the assembly to the housing and remove the GP valve lower half.

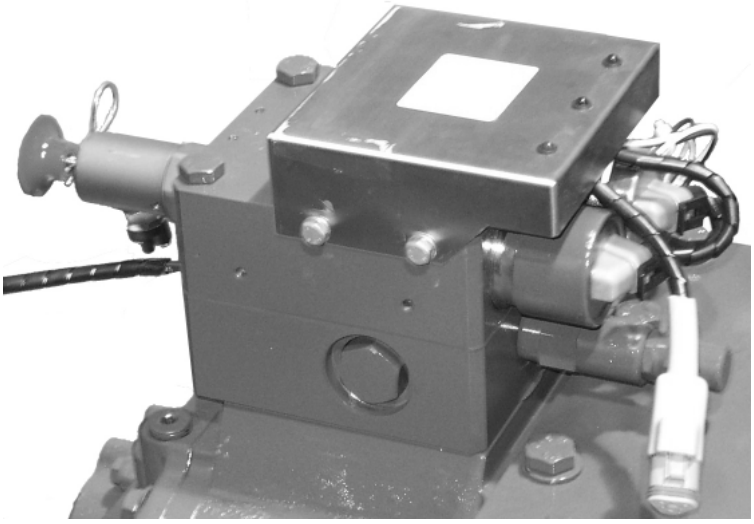


Figure 21. Removing GP Valve Assembly

5. Place the unit on the front housing side. Remove the screw securing the plug cover into the manifold, and screw an eyebolt into the tapped hold in the cover. Remove the cover. Remove the screen filter.

Figure 22. Removing Screen Cover and Screen

6. Remove the three capscrews from the end of the output shaft and remove the retaining washer, rectangular rubber ring, and shims.

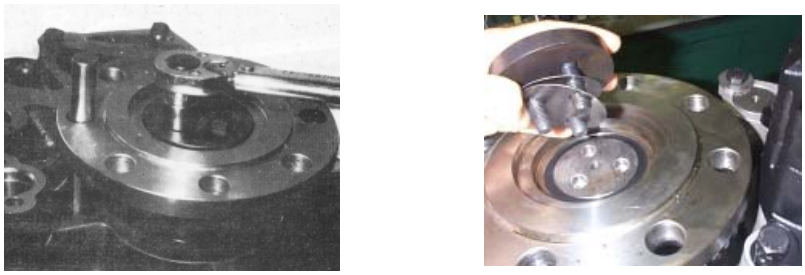


Figure 23. Removing Output Flange Retainer Washer, Capscrew, and Rubber Ring

7. Pull off the output flange.

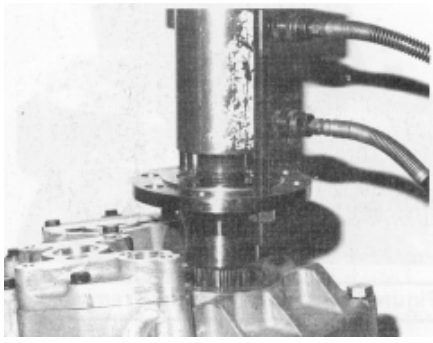


Figure 24. Removing Output Flange

8. Remove the capscrews still securing the manifold onto the rear housing.

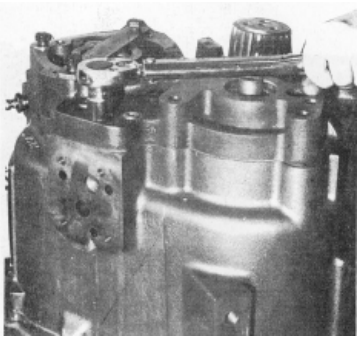


Figure 25. Removing Capscrews on Manifold Assembly

9. Remove the manifold from the rear housing taking care not to damage the piston rings on the end of the clutch shafts. Remove the manifold gasket.

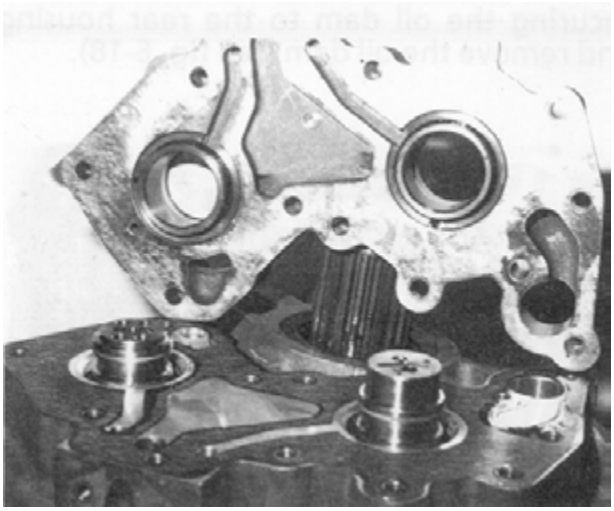


Figure 26. Removing Manifold Assembly

10. Remove the piston ring sleeves and O-rings from the manifold.

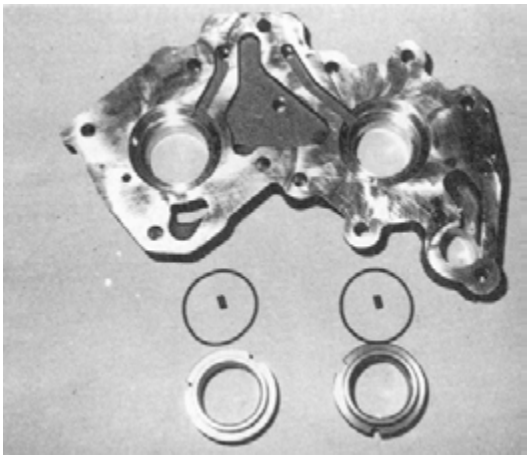


Figure 27. Piston Ring Sleeves and O-rings Removed

11. Turn the unit rear side down on suitable wooden blocks with the front SAE adaptor horizontal. Remove the screws securing the front housing to the rear, and using the jacking screws provided, separate the front and rear housings. Lift off the front housing and gasket.

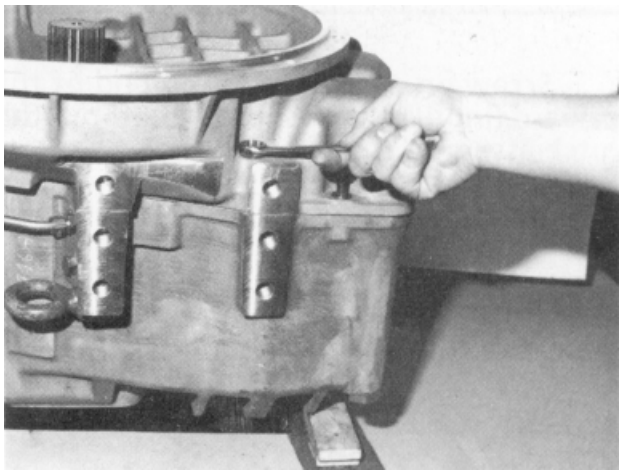


Figure 28. Removing Front Housing Capscrews

12. Remove the oil gauge and tube.

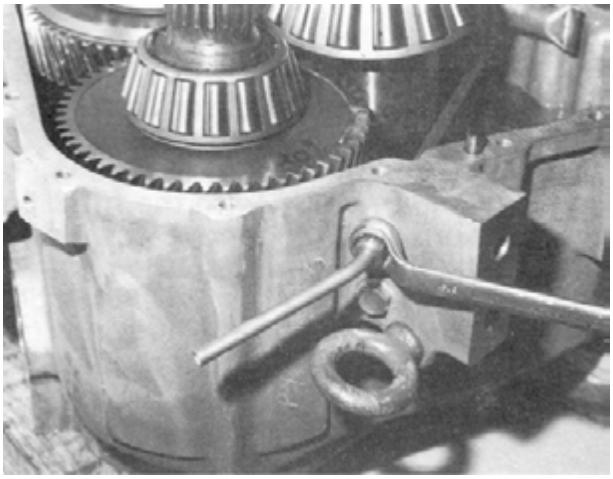


Figure 29. Removing Oil Gauge Tube

13. Drive out the plug in the secondary clutch location from the front housing.

Internal Subassemblies

1. Remove the screws and washers securing the oil dam to the rear housing and remove the oil dam.

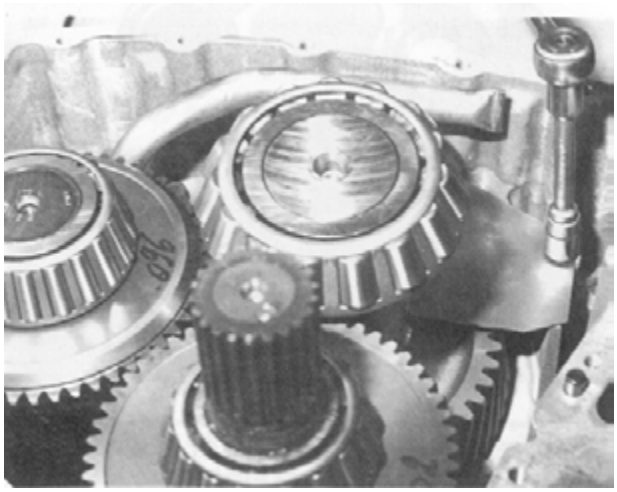


Figure 30. Removing Oil Dam Retaining Screws

2. Screw an eyebolt into the end of the primary (input) clutch shaft and lift out the clutch assembly.

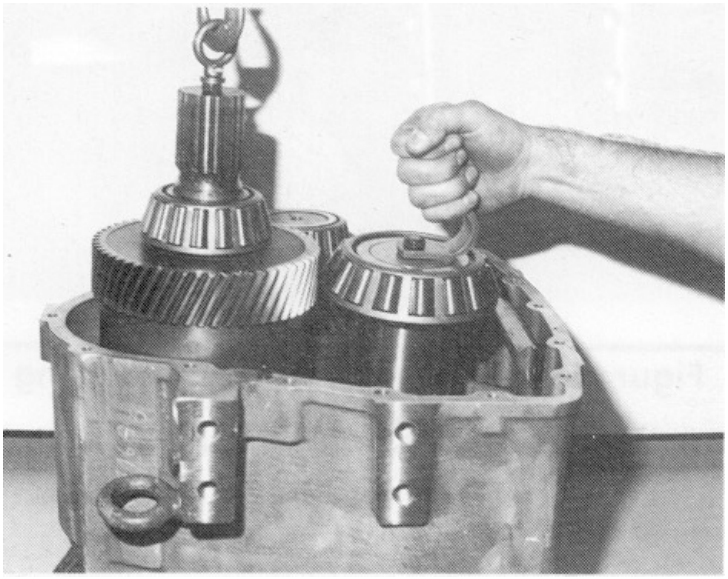


Figure 31. Removing Forward Clutch Assembly

3. Screw an eyebolt into the secondary clutch shaft and lift out the clutch assembly.

4. Lift out the output shaft assembly.

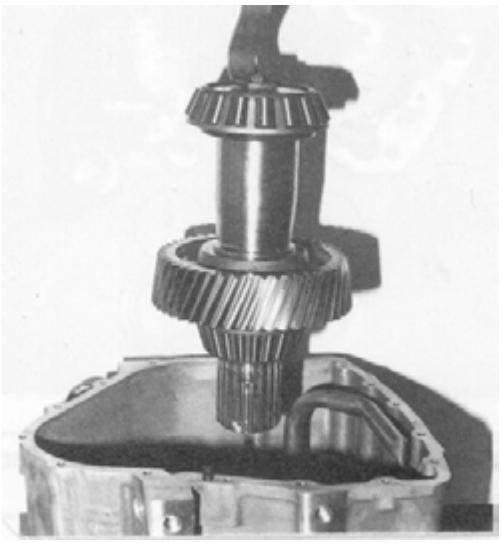


Figure 32. Removing Output Shaft Assembly

5. Remove the Allen head capscrew securing the pump suction tube to rear housing. Remove the suction tube and O-ring.

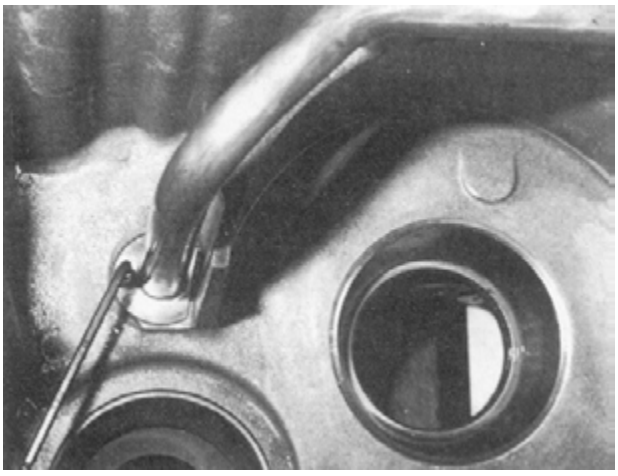


Figure 33. Removing Suction Tube

Disassembly of Primary Clutch

1. Support the primary clutch assembly on the workbench with the output end up.

2. Remove the piston rings from the end of the clutch shaft.

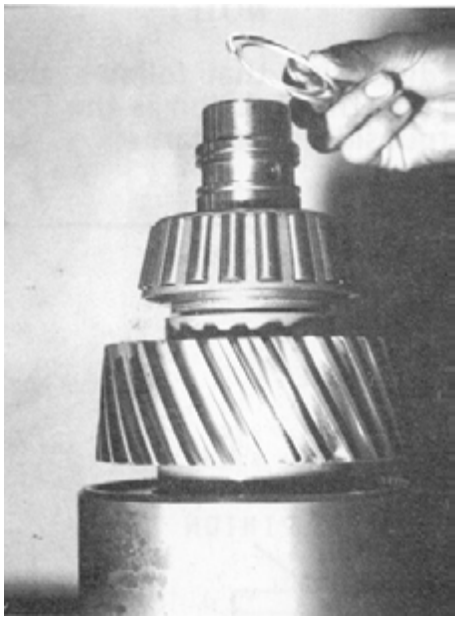


Figure 34. Piston Rings Removed from Clutch Shaft

3. Attach a bearing puller to the inner race of the rear roller bearing or under the pinion according to ratio.

Figure 35. Bearing Puller Installed

⚠ CAUTION

Bearing puller must be installed in a manner which will assure that removal pressure is applied behind the bearing inner cone without binding on the OD of the rear thrust race. Loose adjustment of the bearing puller will result in application of pressure on the bearing cage which will destroy the bearing. Excessively tight adjustment of the bearing puller will exert pressure on the OD of the rear thrust race which will either damage the thrust race or cause the thrust race to bind on the shaft, which could damage the shaft.

4. Place a protective cover over the end of the input shaft and press off the inner race.

5. Remove the primary pinion with rear two thrust races and the thrust needle bearing.

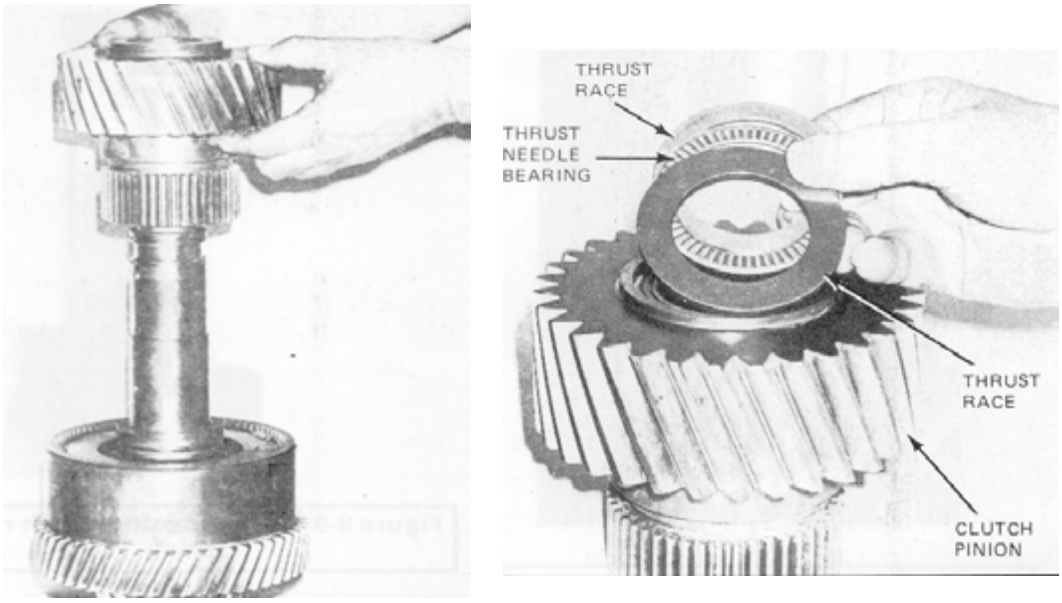


Figure 36. Removing Pinion, Thrust Needle Bearing, and Thrust Race

6. Remove the front two thrust races and needle bearing.

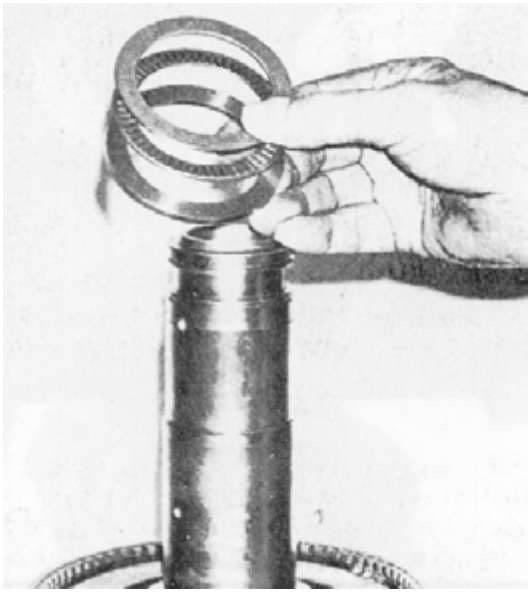


Figure 37. Front Thrust Needle Bearing and Thrust Races Removed

7. Remove the internal snap ring from the inside of the primary clutch housing.

8. Remove the clutch back plate. Figure 8-7.

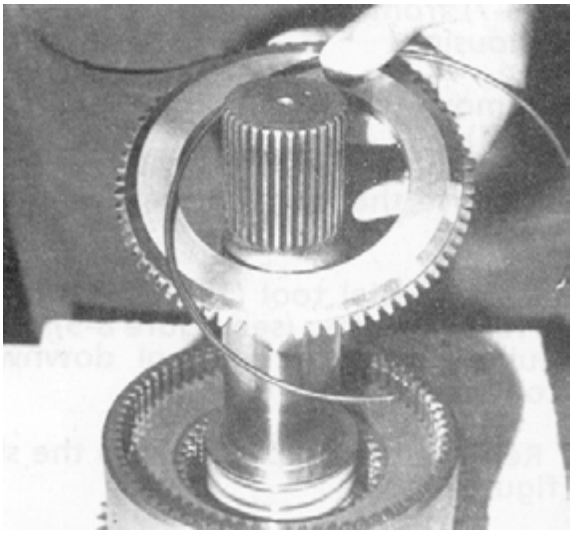


Figure 38. Clutch Backplate and Snap Ring Removed

9. Remove the clutch plates.

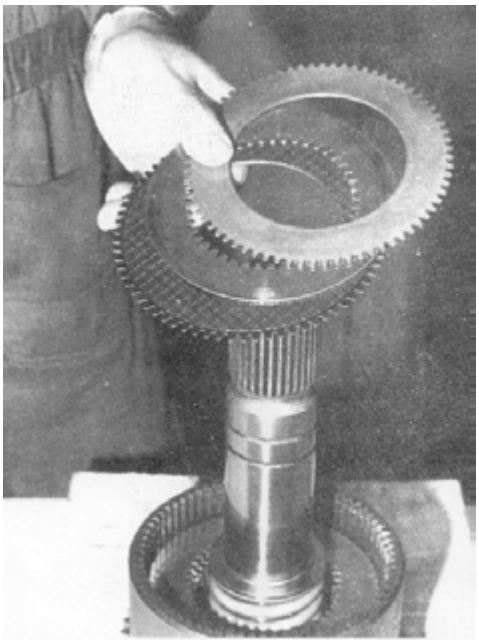


Figure 39. Clutch Plates Removed

10. Place special tool (T-18503) over the clutch release spring. Use a hydraulic press to press tool downward and compress the spring.

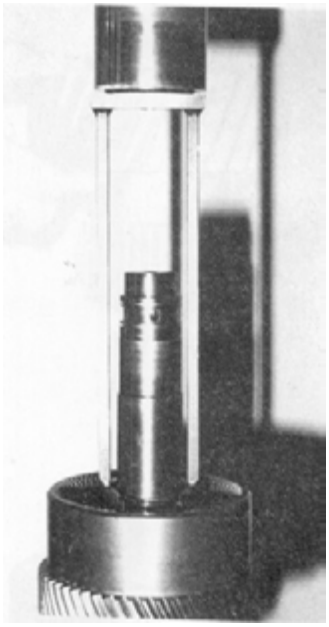


Figure 40. Compressing Clutch Release Spring

11. Remove the snap ring from the shaft.

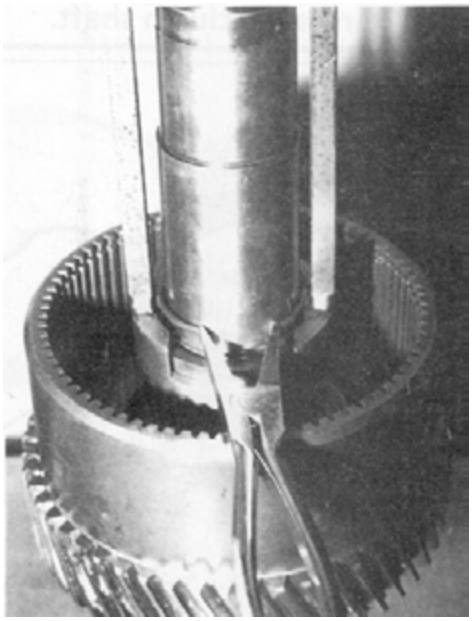


Figure 41. Removing Clutch Release Spring Retaining Snap Ring

12. Remove the clutch release spring and spring retainer.

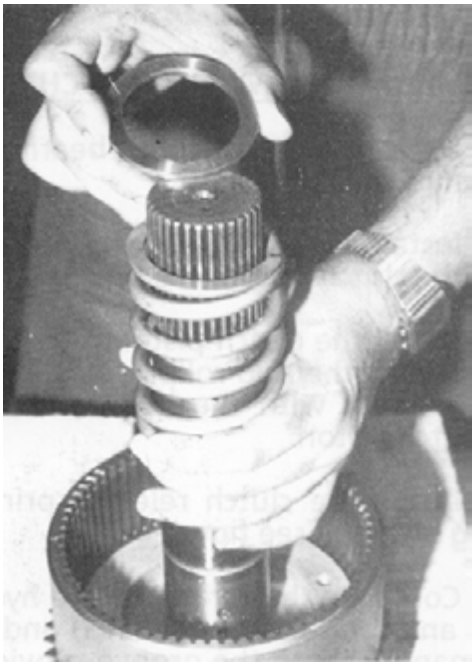


Figure 42. Clutch Release Spring and Retainer Removed

13. Remove the clutch piston by installing two 5/16-18 UNC threaded rods into the holes provided and lifting out the piston.

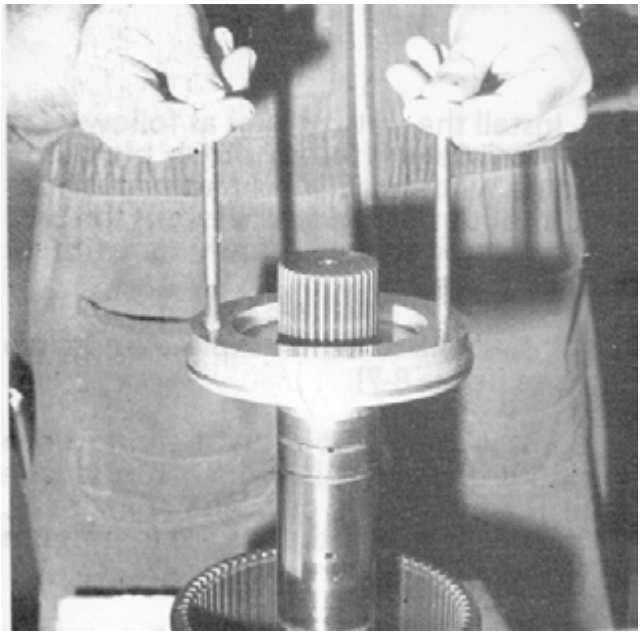


Figure 43. Removing Clutch Piston

14. Remove the piston ring from the outer periphery of the clutch piston, from the outer bore of the small area of the piston, and the O-ring from the inner diameter.

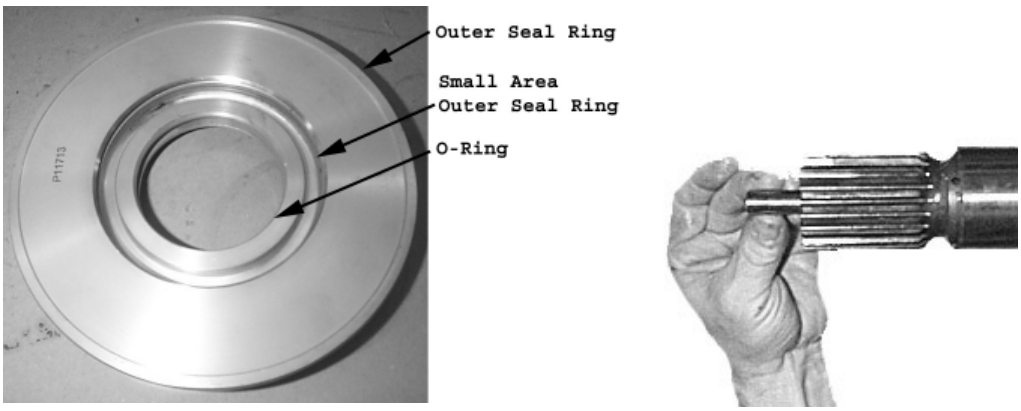


Figure 44. Piston, Piston Ring, and O-ring Removed; Remove S valve

15. Remove the pipe plug from the center bore on the input end, and remove the spacer and “s” valve. A small wire with a hook on the end can be used to help pull the valve out, or air pressure may be applied to the clutch apply port between the sealing rings.

⚠ CAUTION

Do not remove front tapered roller bearings on primary or secondary shaft unless replacement of the parts is necessary. Close tolerances between inner bearing cone and rear face of transfer gears prohibits installation of bearing puller behind inner cone.

If the bearing must be removed, proceed as follows:

a. Split the bearing cage of front taper roller bearing and remove the rollers.

b. Install a cheese-cutter type bearing puller onto the bearing cone, gripping against the shoulder on the cone.

c. Heat bearing inner race by flash heating and remove inner race and cone.

⚠ CAUTION

Prolonged or excessive heating must be avoided so the input and/or secondary shafts will not be annealed.

⚠ CAUTION

Do not remove the driving transfer gear from the input shaft. The shaft and gear are supplied as an assembly.

Disassembly of Secondary Clutch

Disassemble and assemble the secondary clutch in the same manner as the primary clutch. Take care not to install the secondary clutch spring retainer onto the primary clutch, or vice versa. The retainers are not the same.

Note: The “s” valve on the secondary clutch shaft is retained by an orificed plug, and there is no spacer between the plug and the valve.

Disassembly of Output Shaft

⚠ CAUTION

Do not remove tapered roller bearing or output gear from the shaft unless replacement of parts is necessary.

1. If disassembly is required, proceed as follows:

    a. Place the output shaft and gear assembly under a hydraulic press, supported on the gear with the rear (splined) end upwards. Ensure there is sufficient space under the shaft for it to pressed from the gear and bearing.

    b. Place a protective disc on to the end of the output shaft and press on the shaft until it comes free from the taper on the gear.

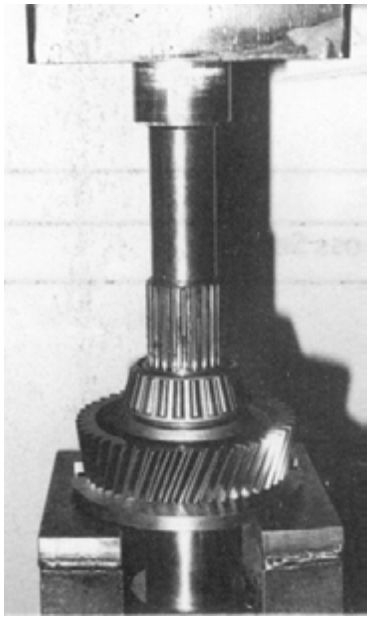


Figure 45. Pressing Output Shaft from Rear Bearing Inner Race and Gear

    c. Continue pressing until the shaft drops free from the rear bearing.

⚠ WARNING

Due to the force required (46-66 tons) to remove the output gear from the output shaft, a protective shield should be placed around the press. Also, the gear should be restrained so it will not fly off of the shaft when it comes loose.

2. Support the output shaft on the front bearing inner race (not the cage) and press the output shaft from the bearing.

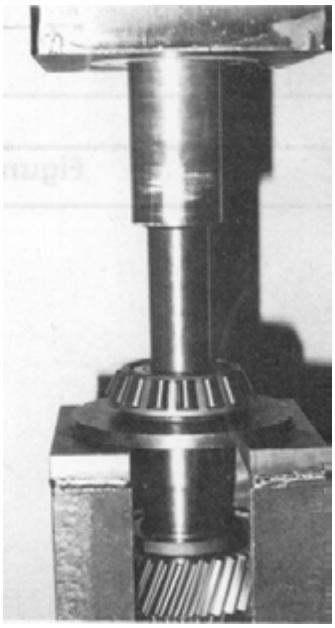


Figure 46. Pressing Front Bearing from Output Shaft

Disassembly of Rear Half Housing

1. Remove oil seal.

2. Use a piece of steel tubing that is slightly smaller in diameter than the roller bearing outer race and press the outer race from the housing.

3. Use an L-type bearing puller to remove roller bearing outer races.

Disassembly of GP Control Valve with Electronic Interface

The GP Valve is made up of a non serviceable electronic interface, and two valve bodies with plugs and cartridges. O-ring kits are available for servicing the plugs and cartridges, however none of the cartridges are field serviceable beyond replacement of the o-rings. The later version (Assembly 1021658) of the hydraulic pressure regulator valve is serviceable, and contains an orifice/ filter plug, and a ball check valve assembly that are replaceable.

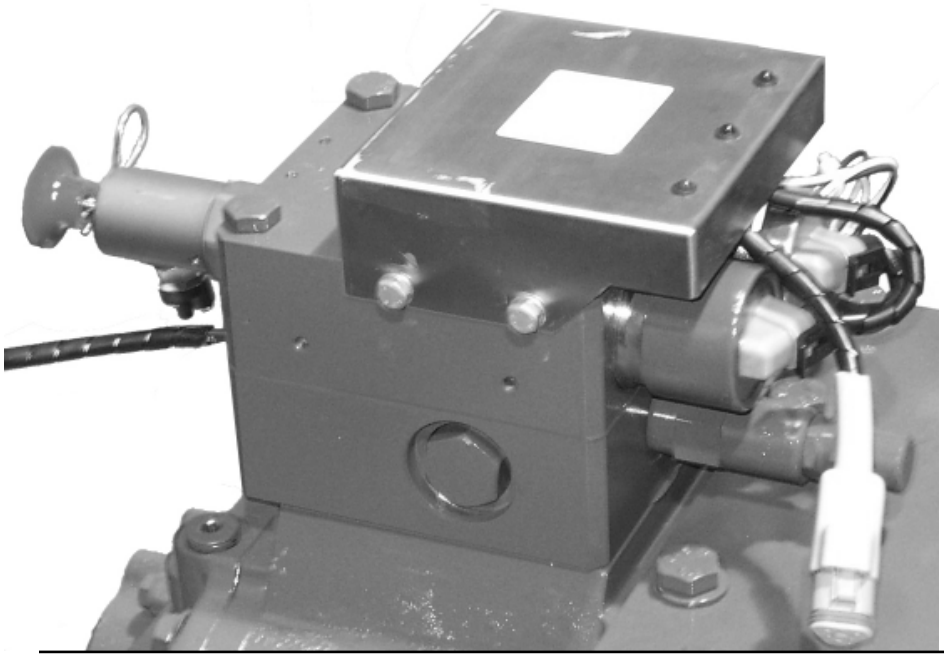


Figure 47. GP Valve Assembly mounted on Marine Transmission.

Disassembly

1. Disconnect the connectors at the proportional valves, the neutral switch, and the temperature sensor (if equipped), and loosen the four M6-1.0 capscrews that retain the Electronic Interface Module to the Hydraulic portion of the valve assembly. If the Electronic Interface is not being replaced, it can be set aside without disconnecting the remaining wires from the installation.

Figure 48. Electronic Profile Module (typical)

2. Remove the six M10-1.50 x 70 capscrews that retain the top valve body assembly to the transmission, and remove the top valve body assembly with gasket (if not previously removed).

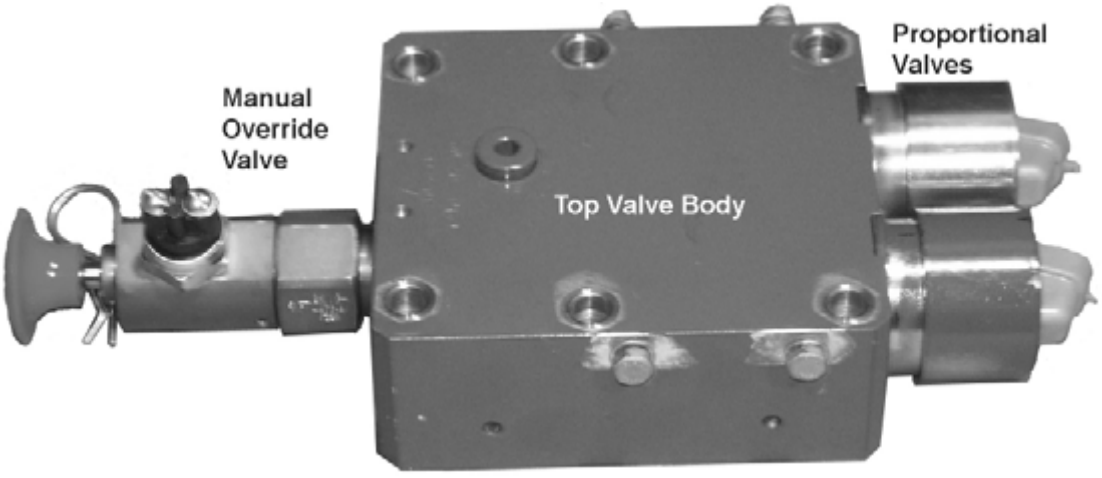


Figure 49. Top Hydraulic Valve Body Assembly

3. Remove the four capscrews that retain the main regulator valve assembly to the transmission housing or ditch plate, and remove the valve assembly and gasket.

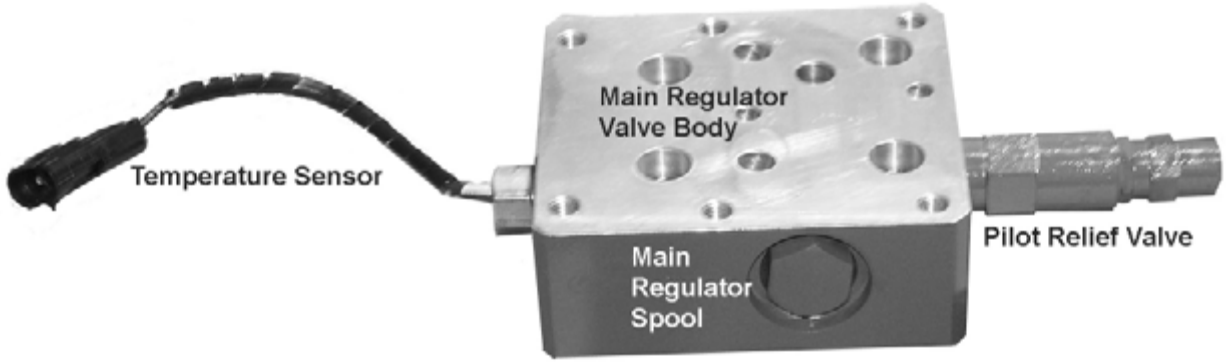


Figure 50. Main Regulator Hydraulic Valve Assembly (1020729)

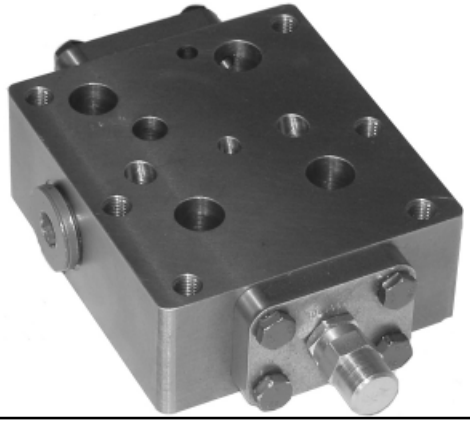


Figure 51. Main Regulator Hydraulic Valve Assembly (1021658)

4. Remove the Manual Direction Control Valve with switch or the Plug Assembly from the Top Valve Body.

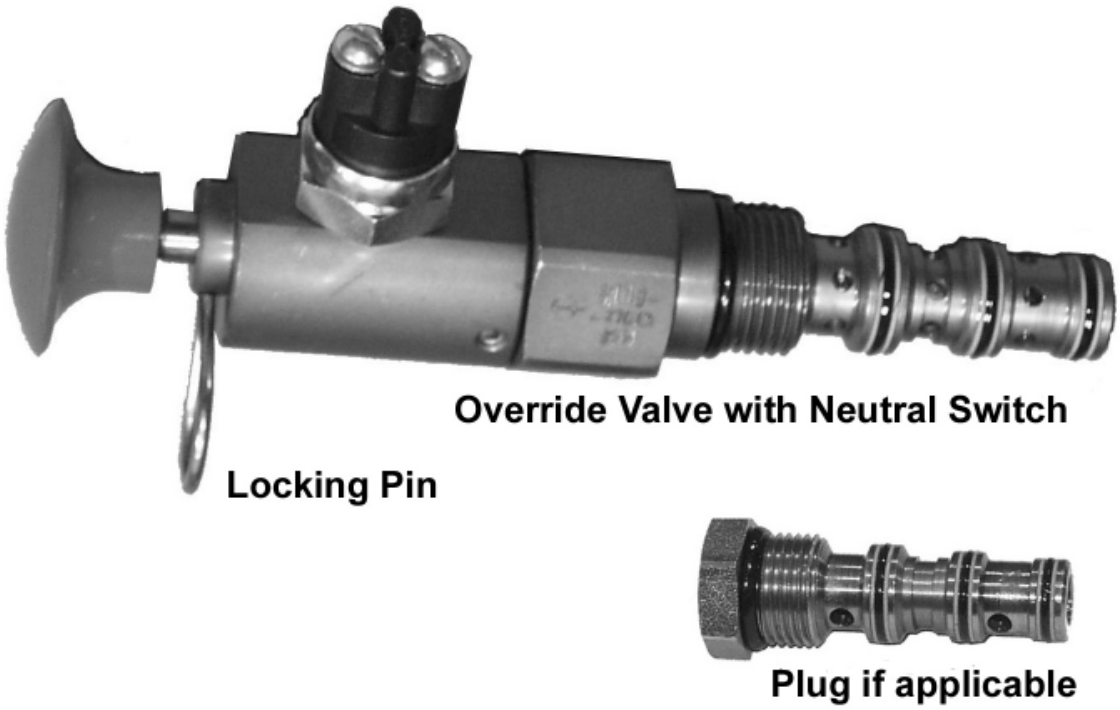


Figure 52. Manual Direction Control Valve or Plug

5. Remove the M6-1.00 x 16 Allen head capscrew, the retaining plate, and the proportional Valve Cartridges from the Top Valve Body. A slight rotating motion while pulling will help to with the removal of the valves.

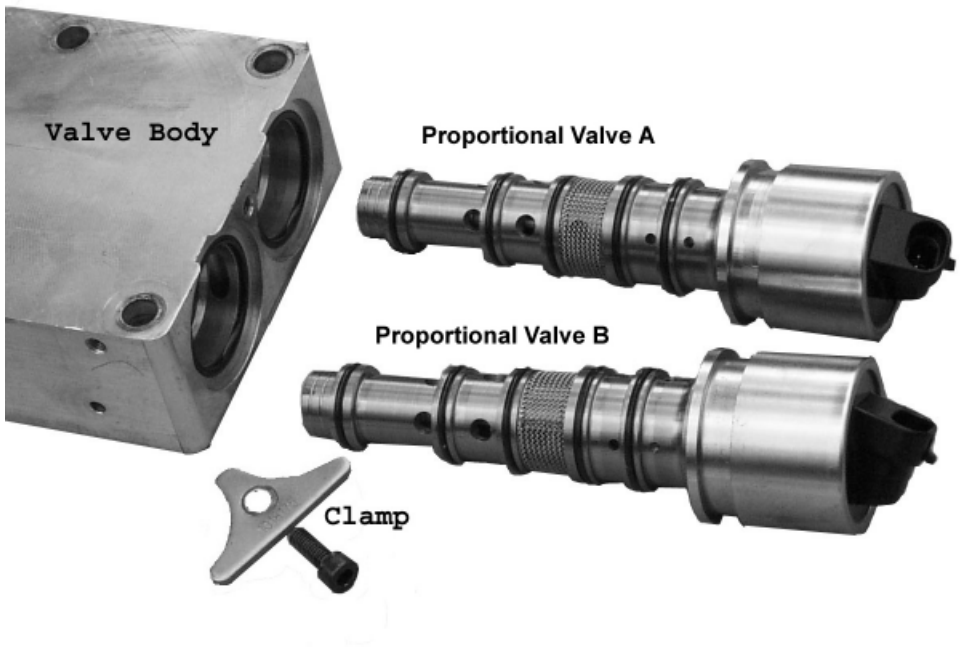


Figure 53. Remove Proportional Valve Cartridges

6. **Valve Assembly 1020729:** Remove the Main Pressure Regulator Pilot Relief Valve and Main Valve from the Main Regulator Valve body.

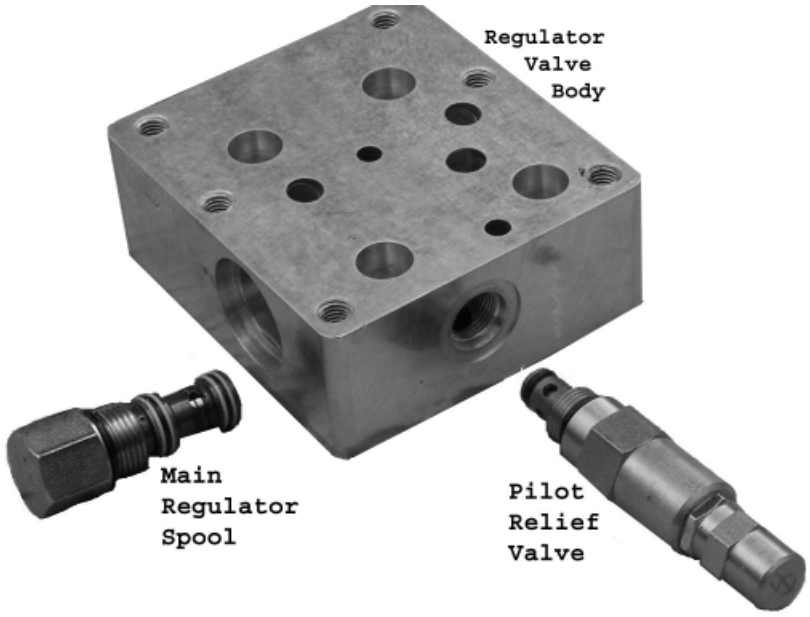


Figure 54. Remove Main Pressure Regulator Valve Components

6. **Valve Assembly 1021658:** Remove the Main Pressure Regulator from the Main Regulator Valve body.

   A. Remove the regulator adjusting screw cap, and loosen the jam nut.

   B. Turn the adjusting screw counter clockwise to reduce the spring load on the valve.

   C. Evenly loosen the four M-8 x 25 capscrews, and remove the cover assembly and gasket, followed by the spring(s) and spool.

   D. Remove the four M-8 x 20 capscrews, and remove the cover and gasket.

   E. Remove the orifice and screen assembly for cleaning.

   F. Remove the ball check assembly only if necessary. Removal will require destruction and replacement of the assembly.

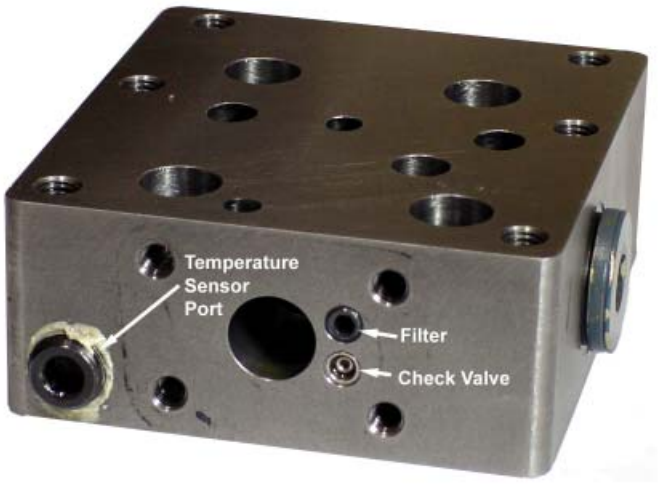


Figure 55. Remove Main Pressure Regulator Valve Components

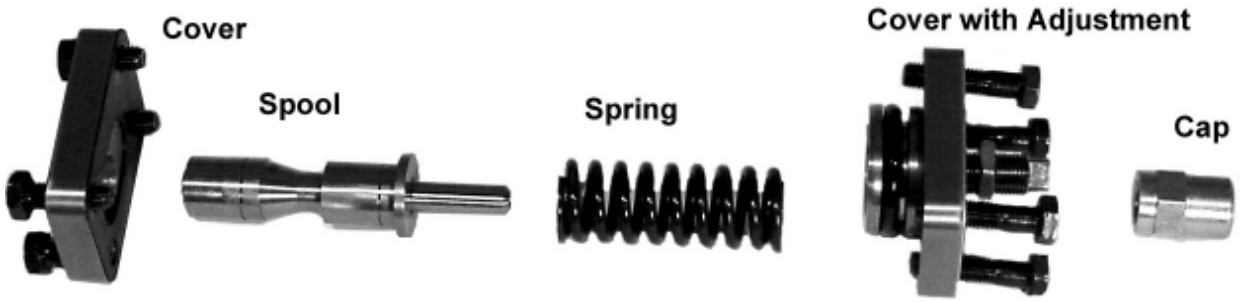


Figure 56. Remove Main Pressure Regulator Valve Components

Cleaning and Inspection

Cleaning

Note: Replace all oil seals, gaskets, O-rings piston rings, seal rings, snap rings, etc., as a part of any maintenance or overhaul procedure. Replace shims that are damaged or destroyed in disassembly.

- ❑ Clean all parts using EPA/OSHA approved solvents or by steam cleaning. Parts must be dried and oiled immediately to prevent corrosion.
- ❑ Examine all parts carefully for grit, dirt and abrasives and reclean them if necessary.
- ❑ Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.
- ❑ Use clean solvent to flush oil pumps, valves, etc.
- ❑ Flush all hoses, tubing, coolers etc., particularly if the unit is being disassembled because of an internal failure.
- ❑ De-burr the housing and bearing carrier with a stone or file in the vicinity of all pusher screw locations.

Cleaning Bearings

Do not remove grease in which new bearings are packed. Thoroughly wash bearings that have been in service. Soak bearings in solvent if they are particularly dirty or filled with hardened grease.

⚠ CAUTION

Never dry bearings with compressed air. Do not spin unlubricated bearings. Oil bearings with SAE 10 engine oil immediately after cleaning. Oil bearings before inspection.

Preventing Dirt from Entering into Bearings

Dirt and grit in bearings are often responsible for bearing failure; consequently, it is important to keep bearings clean. Do not remove grease from new bearings. Keep the wrapper on new bearings until they are installed. Do not expose clean bearings if they are not to be assembled at once. Wrap them with a clean lint-free cloth or paper to keep out dust.

Previously Sealed Joints

- ❑ For previously sealed joints, scrape surfaces to remove old gasket material or loctite.
- ❑ Clean surfaces with solvent to remove oil and grease residue.
- ❑ Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface in a film. If the water puddles or forms beads, use fresh solvent and reclean.

Inspection

Housings, Cast Parts, and Machined Surfaces

- ❑ Replace cast parts or housings that are cracked.
- ❑ Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace deeply grooved or scratched parts. Do not remove excess material by sanding or grinding. This will cause loss of fit of bearings or races.
- ❑ Inspect oil passages for obstructions. If you find an obstruction, remove it with compressed air or work a wire back and forth through the passage and flush it with solvent.
- ❑ Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If you cannot remove the defect with crocus cloth or a soft stone, replace the part.
- ❑ Inspect ground tapers for scratches, galling or scoring damage. If any of these are present, replace the part.
- ❑ Inspect ground tapers for burrs or nicks. If you cannot remove the defect with a soft stone, replace the part.
- ❑ Inspect threaded openings for damaged threads. Chase damaged threads with a tap of the correct size.
- ❑ Inspect studs for damaged threads and looseness. Replace defective studs.
- ❑ Inspect dowel pins for wear or damage. Replace defective dowels.
- ❑ Inspect dowel pin holes for wear due to movement between mating parts. If a dowel pin hole is worn, re-bore and sleeve the hole when possible. Otherwise, replace the parts. This applies where a matched set of parts is not involved.

Valve Seats

Inspect valve seats for burrs, nicks and scratches. If you cannot remove these defects with a crocus cloth, replace the part. Check to see that the valve is seating properly after reworking the valve seat.

Bearings

- ❑ Inspect bearings for roughness of rotation. Replace the bearing if the rotation is rough.
- ❑ Inspect bearings for corrosion, and for indication of wear of balls or rollers. Inspect for scored, scratched, cracked, pitted or chipped races. If you find one of these defects, replace the bearing.
- ❑ Inspect bearing bores and shafts for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If you cannot repair the damage with a crocus cloth, replace the part.

Bushings and Sleeves

Inspect bushings for size and out-of-roundness. Inspect for scores, burrs, sharp edges, and evidence of overheating. Remove scores with a crocus cloth. If the bushing is out-of-round, deeply scored, or excessively worn, replace it.

Thrust Washers and Spacers

Inspect thrust washers for distortion, scores, burrs and wear. Rework or replace any defective thrust washers or spacers.

Gears

- ❑ Inspect gears for scuffed, nicked, burred or broken teeth. If you cannot remove the defect with a soft stone, replace the gear.
- ❑ Inspect gear teeth for wear that may have destroyed the original tooth shape. If you find this condition, replace the gear.
- ❑ Inspect thrust faces of gears for scores, scratches and burrs. If you cannot remove these defects with a soft stone, replace the gear.

Splined Parts

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found.

Springs

Inspect springs for broken or distorted coils. Replace the spring if either of these defects is found.

Flexible Hoses

Inspect all flexible hoses for cracks and sponginess. Replace damaged hoses.

Clutch Plates

Inspect clutch plates for signs of overheating, pitting, or excessive wear of the friction and splined surfaces. Replace the clutch plates if one of these defects is found.

Assembly

Unless otherwise specified, all torque values listed are for capscrews that have been lubricated on the threads and contact surfaces.

The following discussion contains frequent reference to the transmissions parts and components. Refer to Engineering Drawings.

Note: Photos used here are for the purpose of illustrating the procedure and may not appear to be consistent with the previous assembly steps.

Prior to Assembly

Use the following reference: The input side of the transmission is the front and the output side is the rear. Left and right sides are determined by facing the output side of the transmission from the rear.

Note: Special end play tools can be made by grinding 0.05 mm (0.002 in) from the outer diameter of the bearing cups that are used on the input end of the three shafts. These are MA590CK (6.7500 in.), MA590CS (5.0000 in.), and MA590BF (4.8125 in.). Prior to heating the mating bearing cones, and freezing the cups, bearing overall length measurements should be made to determine if any adjustments must be made to the end play calculations based on variances between the unit's bearing cups and the special ground bearing cups.

Identify and place the following bearing components in an oven at 120˚C (250˚F) for 30 minutes: output shaft rear tapered roller bearing cone and the rear bearing cones for both clutch shafts.

Submerge all new friction clutch plates in transmission oil for a minimum of one hour prior to installation.

Identify and place the following bearing components in a deep freeze -51˚C (-60˚F) for at least two hours prior to assembly: both output bearing cups, and both rear clutch shaft bearing cups.

Assembly of Housing Sections

1. Install roller bearing outer races and press them into the rear housing Oil after installation.

2. Coat the output seal bore of the rear housing and the outside diameter of the output seal with a thin film of M2828 anaerobic sealant (do not apply excessive sealant, as seal and/or bearings may be damaged). Apply a film of oil or assembly grease to the seal surface. Press the oil seal into the bore with the spring-loaded lip of seal toward the inside of the housing. Press seal into bore until outer face is flush with the housing face.

3. Coat the input seal bore of the front housing and the outside diameter of the input seal with a thin film of M2828 anaerobic sealant (do not apply excessive sealant, as seal and/or bearings may be damaged). Apply a film of oil or assembly grease to the seal surface. Press the oil seal into the bore with the spring-loaded lip of seal toward the inside of the housing. Press seal into bore until outer face is flush with the housing face.

Assembly of Primary Clutch

1. Plug the “s” valve end of the shaft, but do not install the valve.

2. Install the heated front bearing inner race onto the input shaft (if removed).

   Note: Heat the front bearing cone in a 135°C (275°F) maximum oven for 30 minutes prior to installing it on the shaft.

3. Install a new piston ring and O-ring onto the clutch piston.

4. Install the clutch piston aligning the two roll-pins in the driving transfer gear with the holes provided in the clutch piston.

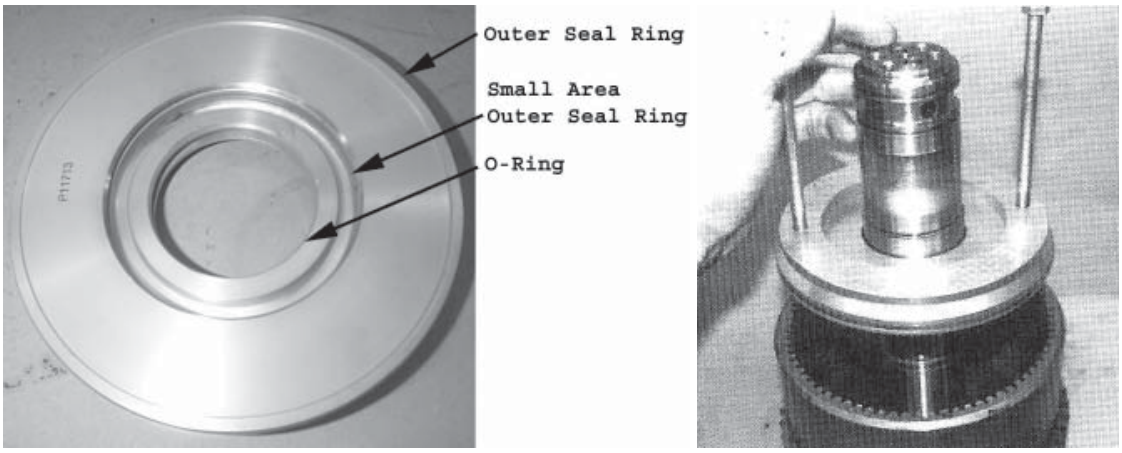


Figure 57. Installing Clutch Piston

5. Install the clutch release spring and spring retainer. Note tha the forward retainer is thinner than the reverse retainer.

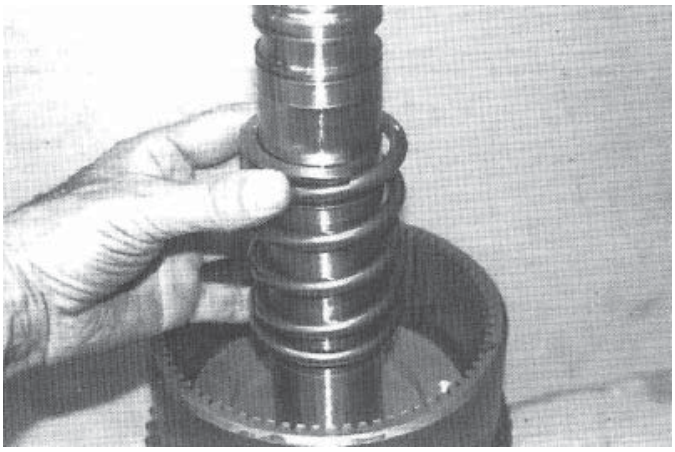


Figure 58. Installing Clutch Release Spring and Retainer

6. Compress the spring using a hydraulic press and Special Tool (T18503) and install the snap ring into the groove provided on the input shaft.

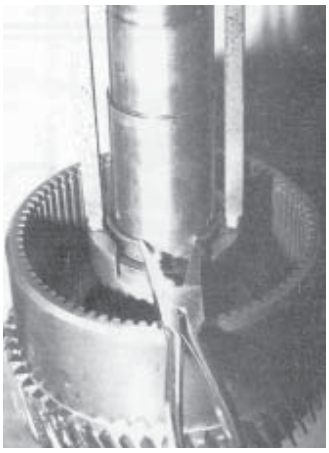


Figure 59. Installing Clutch Release Spring Retaining Snap Ring

7. Install the clutch plates as follows: Install a friction (faced) clutch plate and alternate with steel and friction plates until the ten steel and eleven friction plates are installed, finishing with a friction plate.

   Note: Submerge all friction plates in clean SAE 40 engine oil for one hour minimum prior to installation.

8. Install the clutch backplate and snap ring.

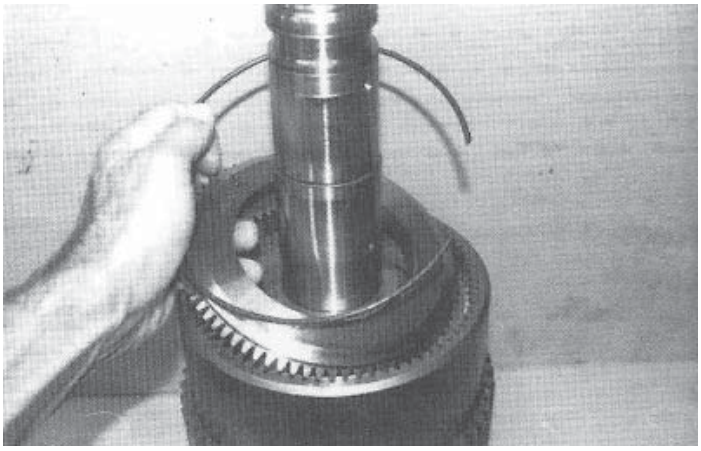


Figure 60. Installing Clutch Backplate and Snap Ring

9. Place the shaft vertically with the backplate at the top of the clutch assembly. Apply a load of 100-200 N (23-45 lbf.) to the backplate.

10. Using a dial indicator, set zero at the bottom position for the backplate. Apply air pressure to the clutch apply hole located between the two sealring grooves. Measure the clutch clearance on the dial indicator.

    Clutch clearance must be between 2.30-4.00 mm (.091-.157 in.).

11. If the clutch clearance is out of the specified range, shim the clutch using steel clutch plates—2.34-2.38 mm (0.092-0.094 in.) thick, friction plates—3.07-3.20 mm (0.121-0.126 in.) thick, or cores from friction plates—1.54-1.57 mm (0.061-0.062 in.) thick.

    Note: When shimming using a friction plate or a core plate, the additional plate must be located between the backplate and the last active friction plate. When shimming using a steel plate, the additional plate must be located between the last active friction plate and the last active steel plate.

12. The two front thrust bearing races are designed with different inside and outside diameters. Install the front thrust bearing onto the input shaft in this order: thrust race (with the smaller I.D.; the I.D. pilots on the shaft), needle bearing, and thrust race (with the larger O.D).

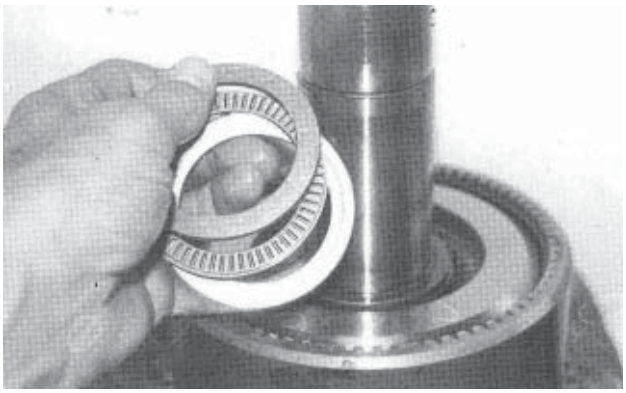


Figure 61. Installing Front Thrust Needle Bearing and Thrust Races

13. Pre-align splined teeth on steel clutch plates and install the forward pinion onto the input shaft aligning the steel plates with the splines on the pinion.

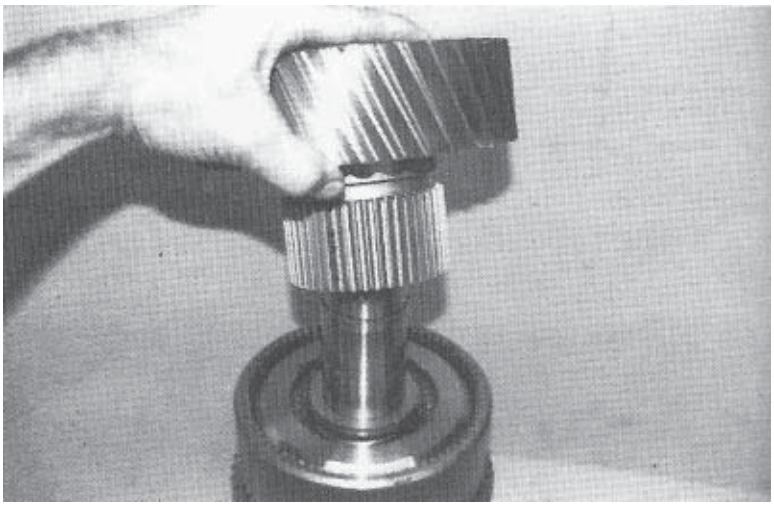


Figure 62. Installing Pinion on Clutch Shaft

14. Calibrate the S-Valve, following the procedure shown in Special Tools section. Lubricate the external o-ring.

15. Install the “s” valve into the bore in the center of the input shaft, followed by the spacer and orificed set screw. Apply Loctite 242, and torque the M18 x 1.5 setscrew to 14 Nm (10 lb-ft.).

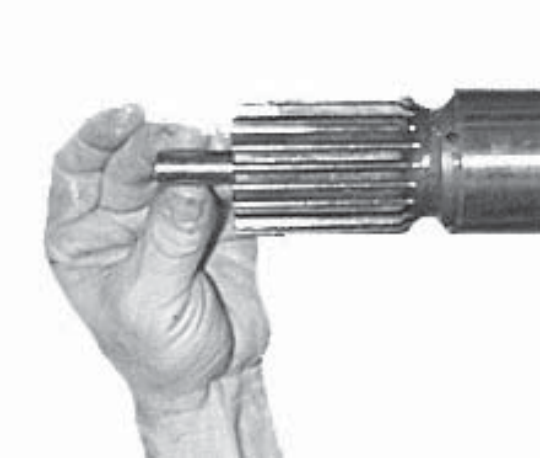


Figure 63. Install S Valve

16. The two rear thrust bearing races are designed with different inside and outside diameters. Install the rear thrust bearing onto the forward pinion in this order: thrust race (with the smaller O.D.; the O.D. pilots in the pinion bore), needle bearing, and thrust race (with the larger O.D.; this thrust race pilots on the shaft).

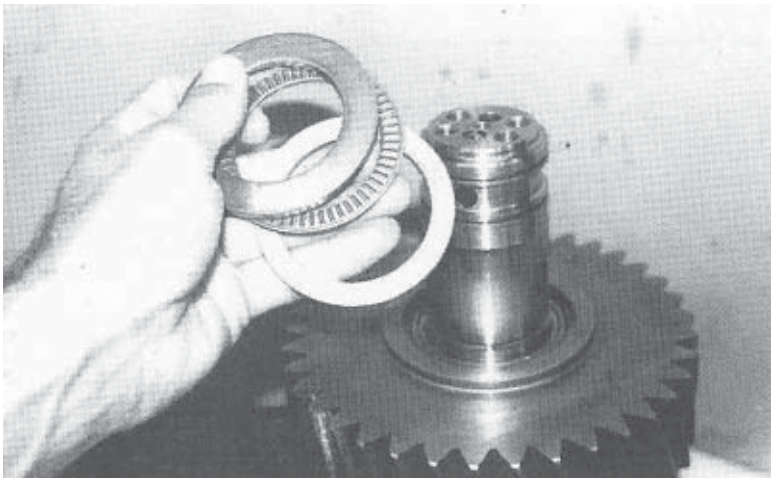
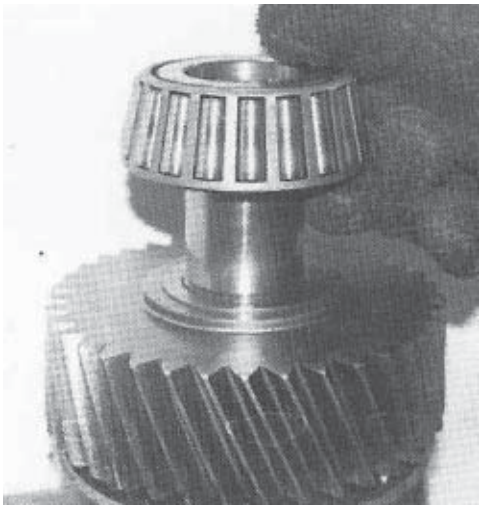


Figure 64. Installing Rear Thrust Needle Bearing and Thrust Races

17. Install the heated inner race onto the input shaft.



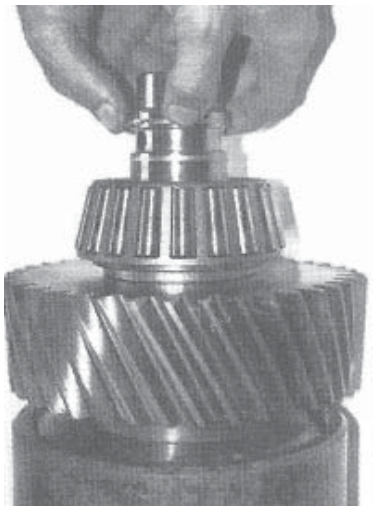


Figure 65. Installing Heated Rear Bearing Onto Clutch Shaft

18. Install the piston rings on the clutch shaft.

Assembly of Secondary Clutch

Assemble the reverse clutch in the same manner as the forward clutch. Take care not to install the reverse clutch spring retainer onto the forward clutch, or vice versa. The retainers are not the same.

Note: There is no spacer following the installation of the “s” valve.

Assembly of Output Shaft

1. Assemble the output shaft and gear as follows:

   a. Degrease the tapered bore of the gear and its mating surface on the output shaft with 1, 1, 1-trichlorethylene which meets OSHA requirements.

   b. Remove all traces of grease and oil from the tapered surfaces. Dry with clean paper towels.

⚠ CAUTION

Do not chill the shaft nor heat the gear.

   c. With a felt marker, mark a spot on the rear end of the shaft. Measure and record the distance (X), at the spot, from the end of the shaft to where the gear seats.

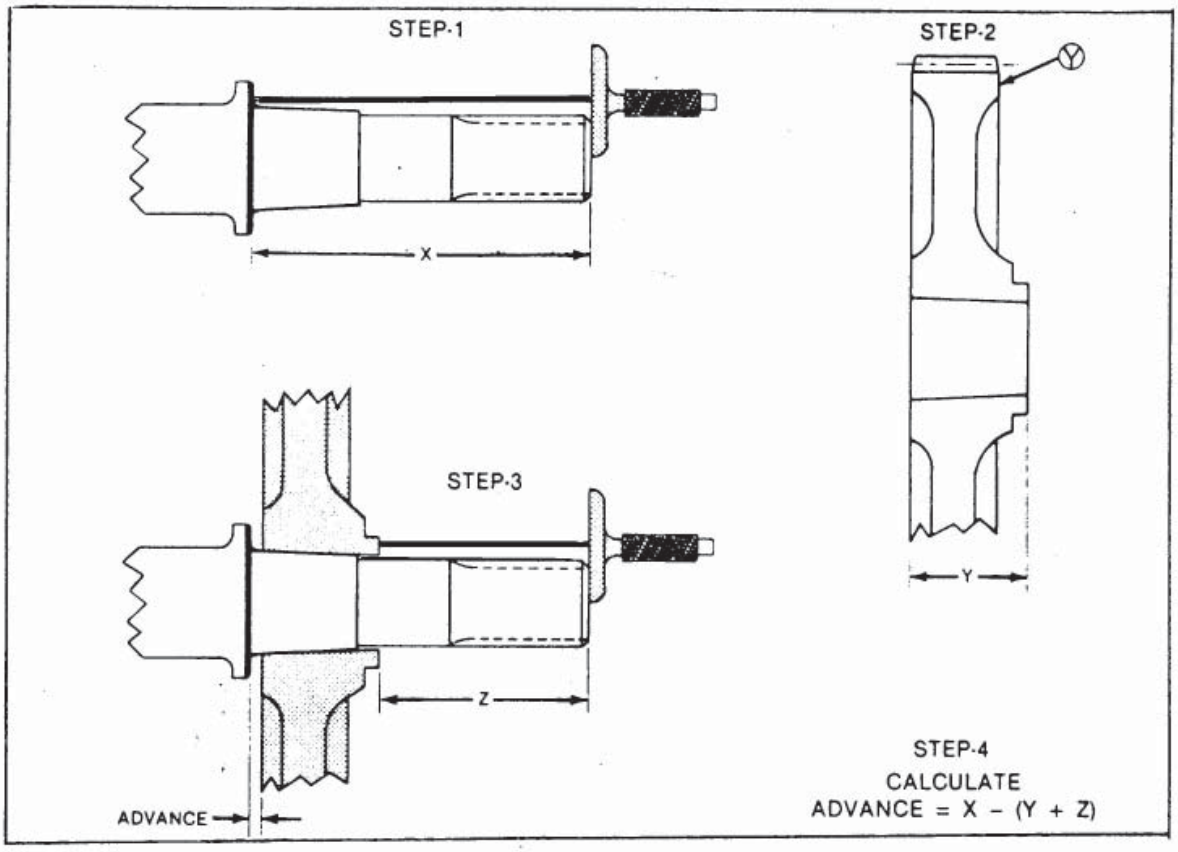


Figure 66. Calculate Advance

d. Measure with outside micrometers and record the thickness (Y) of the gear at the bore.

e. Install the gear onto the shaft and use 200-300 lbs max. force to seat it on its taper.

f. Measure from the marked spot on the end of the shaft (Z) to the gear hub.

g. The advance = X - (Y+Z).

h. The advance must be .088 to .120 inches in order to ensure correct assembly.

i. Support the output gear under the hydraulic press and press on the front end of the shaft to advance the shaft up to the shoulder.

⚠ CAUTION

Pressure of 43-59 tons is required to install the output gear. Therefore, the press should be shielded as a precaution.

2. Place the output shaft and gear assembly between centers and check the runout. Maximum allowable runout at gear face is .005 T.I.R. If runout exceeds .005, remove the gear following the steps give for removal above. Turn the gear 180° and reinstall it, following the steps above for installing the gear. Check runout again.

3. Heat inner races of roller bearings in a 120°C (250°F) oven for not more than thirty minutes.

4. Install the inner races. Allow them to cool and then seat them (pressing on the cone only) against the shoulders on the shaft.

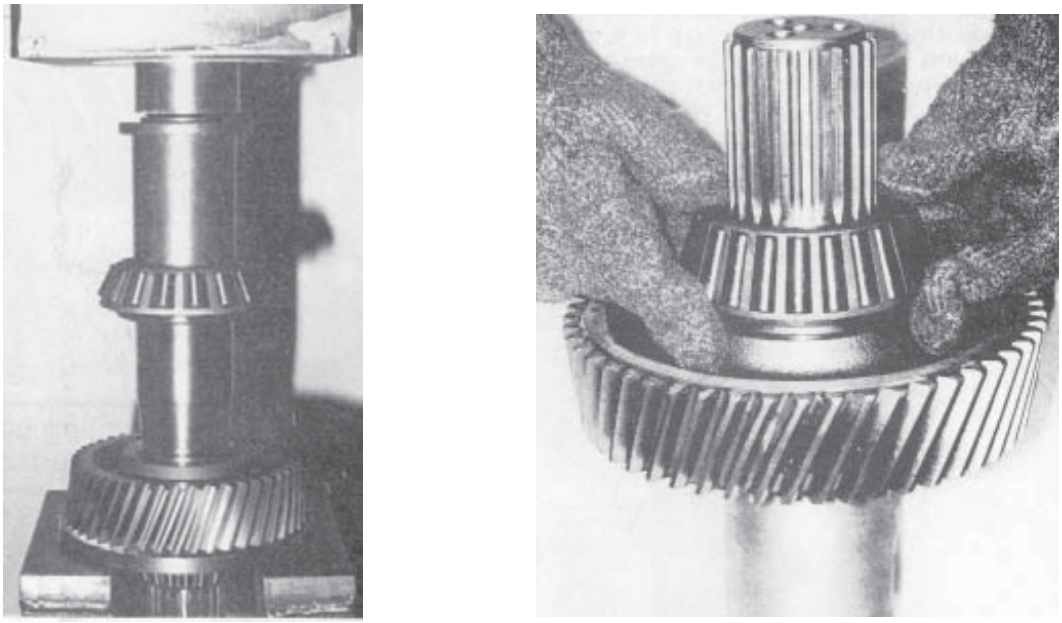


Figure 67. Pressing Front Bearing Onto Output Shaft and Installing Inner Races

Installation of Shafts and Clutch Assemblies

1. Install the oil suction tube. Install the M6 x 12 socket head capscrew and torque to 9.5 Nm (7 lb-ft.)

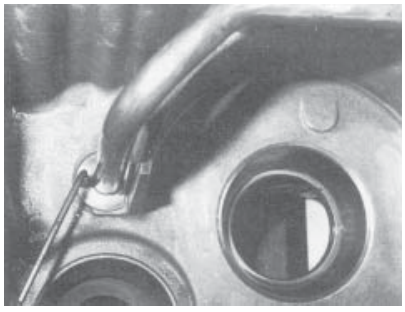
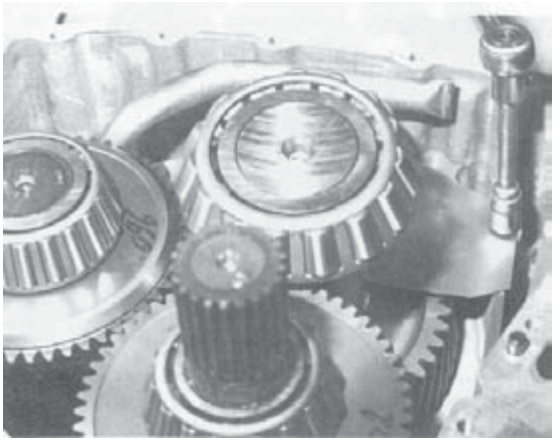


Figure 68. Installing Oil Suction Tube

2. Install the shim retainers and special ground tapered roller bearing outer races into the front housing.

   Note: Do not install adjusting shims at this time.

3. Install the output shaft group into the rear housing. Install the oil dam and secure with the two screws and washers. Torque the two M10 x 20 retaining screws to 46 Nm (34 lb-ft.)



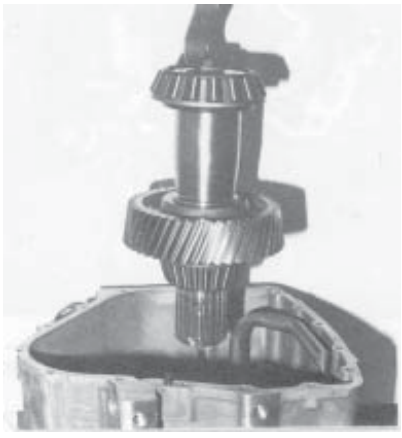


Figure 69. Installing Oil Dam Retaining Screws and Output shaft Assembly

4. Install the forward and reverse clutch groups into the rear housing.

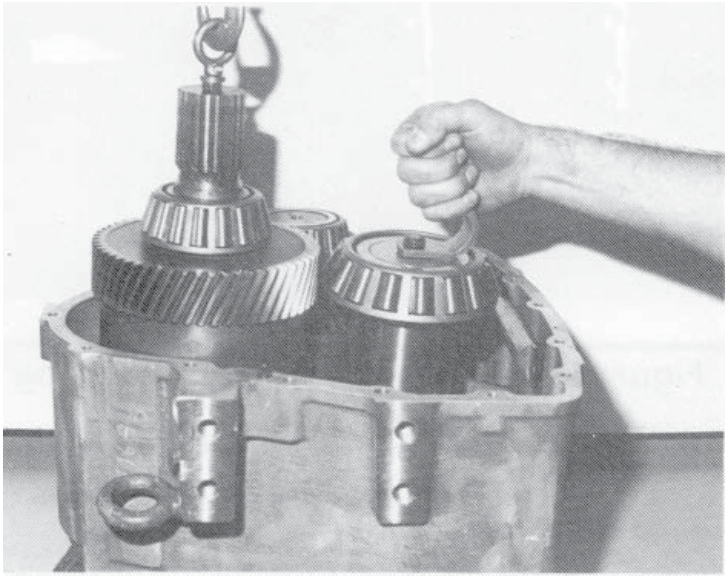


Figure 70. Installing Forward Clutch Assembly

5. Install the gasket onto the rear housing and install the front housing, and twelve M10 x 35 screws and washers. Torque the screws to 45 Nm (34 lb-ft.).

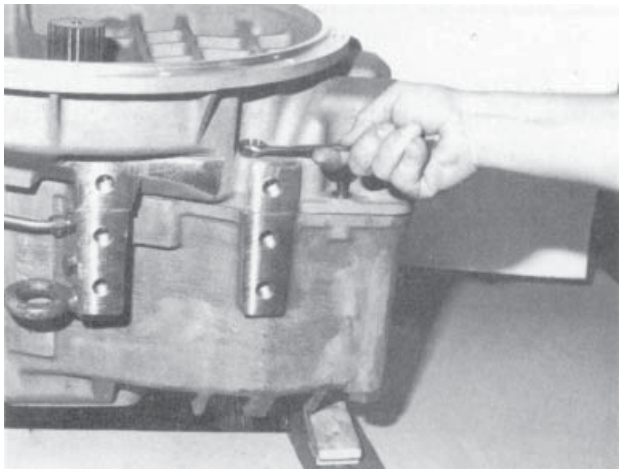


Figure 71. Installing Front Housing Capscrews

6. Check the endplay of all three shafts as follows:

   a. Install the endplay adjustment fixture TD-300388 to the front end of the forward shaft and attach a dial indicator securely onto the housing so that the indicator finger rests on the end of the clutch shaft.

   b. Apply to the shaft a downward load of at least its own weight. Maintain this load while rotating the shaft several times, and set the indicator to zero.

   c. Use a fish scale and apply an upward load of at least twice the weight of the shaft. The indicator movement will be the endplay. Record the forward shaft end play.

   d. Repeat operations a, b, and c on the reverse and output shafts. Record the respective endplays.

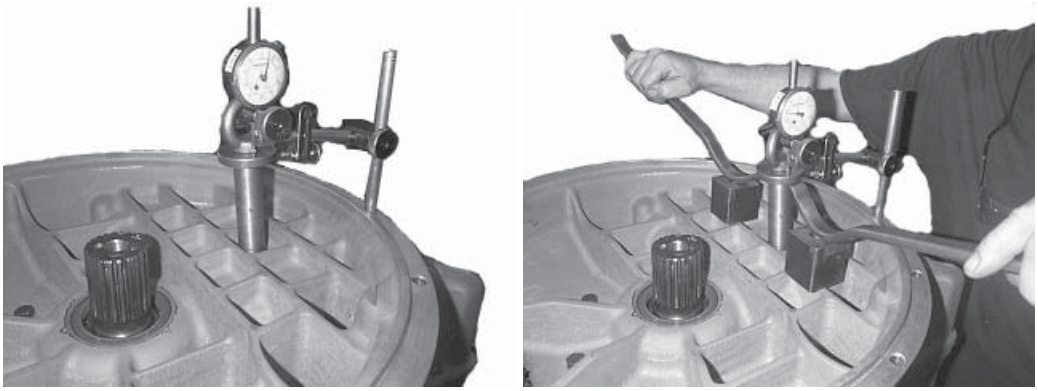


Figure 72. Checking Endplay

7. Remove the front housing from the unit. Remove the special ground bearing outer races and shim retainers from the housing.

Note: Do not interchange the forward and reverse shim retainers. They must be replaced in the bores from which they came.

8. Place a pack of shims in each bearing bore so as to measure an interference of 0.051 to 0.102 mm (0.002 to 0.004) in for the clutch shaft, and 0.051 to 0.13 mm (0.002 to 0.005) in for the output shaft..

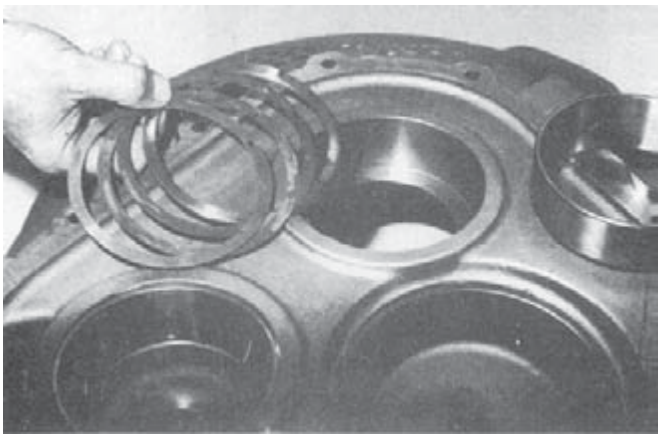


Figure 73. Installing Shims

Example:

Endplay recorded = 1.194 mm (.047in.)
Interference required = 0.076 mm (.003 in.) nominal
Shim thickness required: 1.194 + .076 = 1.27 mm
(.047 +.003 =.050 in.)

9. Replace shim retainers and bearing out races into their respective bores in the front housing.

10. Replace front housing and gasket on the rear housing and secure with twelve M10 x 35 screws and washers. Torque the screws to 45 Nm (34 lb-ft.).

11. Turn the unit rear side up on the work bench.

12. Install the gasket and the manifold and secure with the M12 capscrews. Torque the screws to 80 Nm (59 lb-ft.). Ensure that the piston rings are correctly in place on the ends of the clutch shafts.

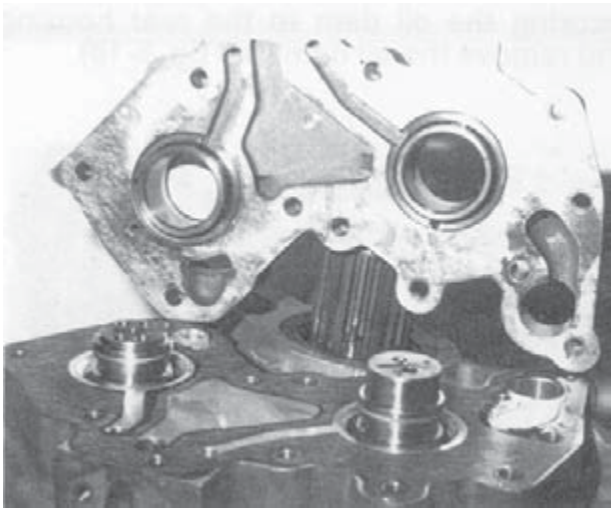


Figure 74. Installing Manifold Assembly

13. Install the oil filter screen and O-ring plug and secure with the screw and washer. Torque the M 12 retaining screw to 80 Nm (59 lb-ft.).

Figure 75. Installing Screen Filter

14. Install the gasket and the oil pump. Verify the proper orientation of the pump for the engine rotation. (See Engineering Drawings, PX11790 sheet 2) Ensure that the pump drive tang is correctly engaged in the slot in the end of the reverse shaft. Torque the M 12 retaining screws to 80 Nm (59 lb-ft.).

Figure 76. Installing Hydraulic Pump Retaining Capscrews

15. Install the output flange being careful not to damage the oil seal when engaging the runway of flange. This operation has to be done by aid of special tool TD-300389 and 10-ton hydraulic press. An alternative assembly procedure is to heat the flange in a 120°C (250°F) oven for no more than 30 minutes. Coat the spline of the shaft with Molykote grease, and carefully lower the heated output flange onto the shaft. Be sure that it is bottomed.

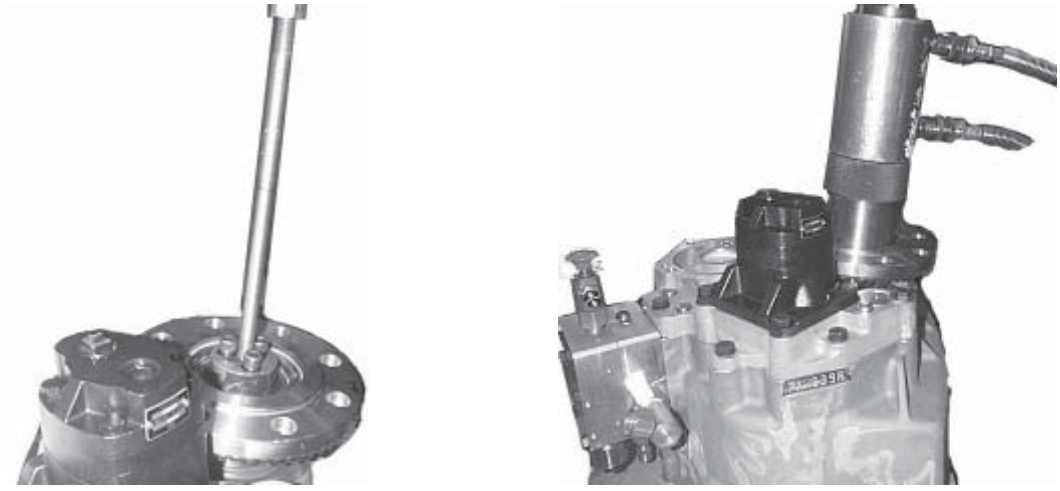


Figure 77. Installing Output Flange

16. Measure the gap from the shoulder of output flange on which the retainer washer rests on to the end of the output shaft. Add shims .003 to .006 inch thinner than the gap. Install rectangular rubber washer and retainer washer.

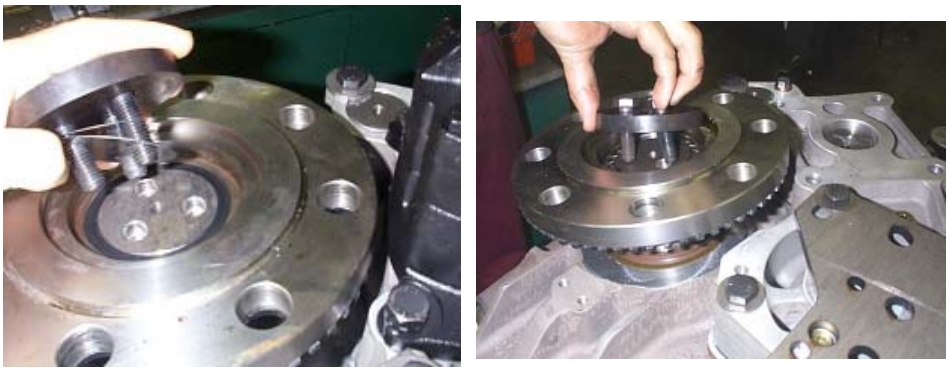


Figure 78. Installing Output Flange Retainer Washer and Rubber Ring

17. Apply Loctite 242 to the three M12 x 30 capscrews, and secure the retainer washer. Torque the retaining screws to 80 Nm (59 lb-ft.).

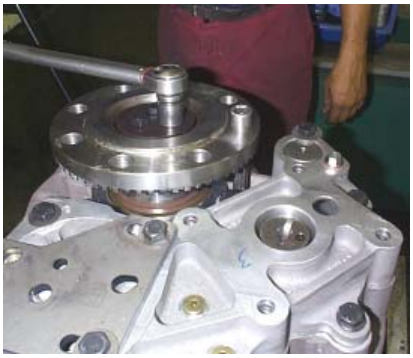


Figure 79. Installing Output Flange Retainer Washer and Capscrew

18. Install the output speed pickup bracket using two M8 x 22 screws with washers. Torque the retaining screws to 23 Nm (17 lb-ft.)

19. Slide input coupling onto splines of input shaft. If the unit is to be shipped with the coupling on the shaft, it must be attached to prevent it from sliding off and causing damage.

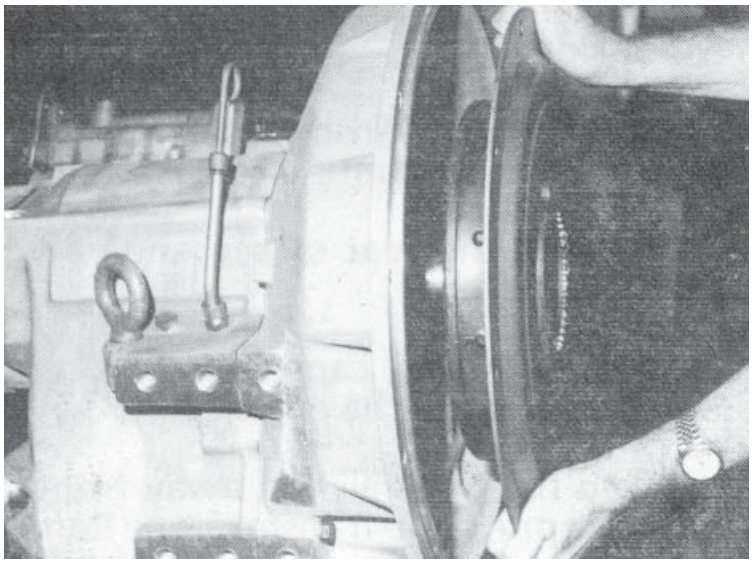


Figure 80. Installing Input Coupling

20. Install the output speed pickup (on E-Troll units only). Turn speed pickup until it touches the gear tooth o.d. and back off two complete turns and tighten the jam nuts to 27 Nm (20 lb-ft.)

21. Install the input speed pickup (on E-Troll units only). Turn speed pickup until it touches the gear tooth o.d. and back off one complete turn and tighten the jam nut to 27 Nm (20 lb-ft.). If no speed pickup is used, install the plug and o-ring, and torque to 88 Nm (65 lb-ft.).

Assembly of GP Control Valve with Electronic Interface

Prior to assembly, all parts must be properly cleaned. Carefully inspect all o-rings for any damage, and replace as necessary. Lubricate all o-rings, and replace both gaskets.

1. **Valve Assembly 1020729**: Assemble the Main Regulator Valve body.

   A. Install the Main Pressure pilot relief valve into the valve body and torque to 27 Nm (20 Ft-lb).

   B. Install the Main Valve into the valve body and torque to 33 Nm (24 Ft-lb).

   C. Install the 3/8 nptf pipe plug or optional temperature sensor into the valve body and torque to 23 Nm (17 Ft-lb).

   D. Install the M27x2.0 o ring plug into the valve body and torque to 75 Nm (55 Ft-lb).

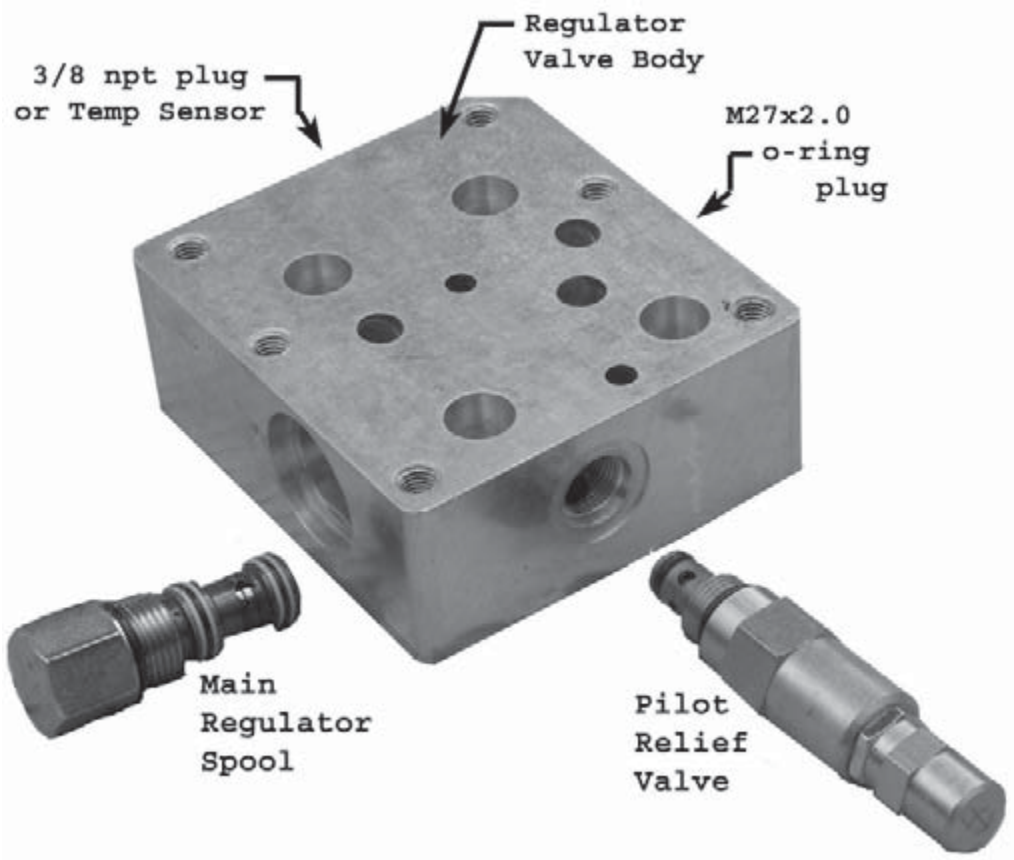


Figure 81. Main Pressure Regulator Components Assembly 1020729

1. **Valve Assembly 1021658**: Assemble the Main Regulator Valve body.

   A. Install the filter into the threaded hole of the valve body, and torque to 7.5 Nm (5.5 Ft-lb). If removed, install a new check valve assembly into the bore of the valve body, and drive it with a drift until it is flush with the face of the body. Install the 3/8 nptf pipe plug or optional temperature sensor into the valve body and torque to 23 Nm (17 Ft-lb).

   B. Install the gasket and cover without the adjustment screw to the valve body with four M8 x 20 capscrews and torque to 23 Nm (17 Ft-lb).

   C. Install the spool with washer, and spring into the bore. Install the gasket, and cover with the adjustment screw, using four M8 x 25 capscrews. Evenly tighten the capscrews, and torque to 23 Nm (17 Ft-lb).

   D. Install the cap onto the adjusting screw finger tight as the main pressure must be set at the time of installation or testing.

Figure 82. Assemble Main Pressure Regulator Components

2. Assemble the Top Valve Body. Install the two proportional valve assemblies into the valve body, install the retaining plate, and torque the M6-1.00 x 16 socket head capscrew to 9.5 Nm (7 Ft-lb). Install the Manual Direction Control Valve into the valve body, and torque to 27 Nm (20 Ft-lb). Install the M12x1.50 o-ring plug into the valve body and torque to 16 Nm (12 Ft-lb). Connect the wires for the Neutral Switch.

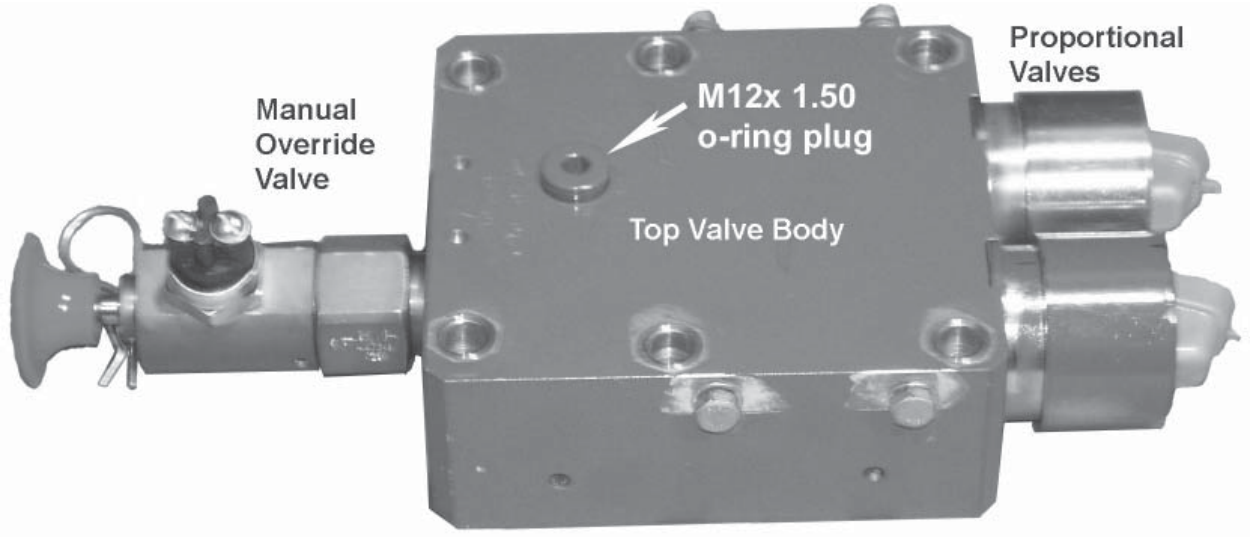


Figure 83. Assemble Top Valve Body Components

3. Install a new gasket, and the Main Regulator Valve Assembly to the transmission or ditch plate, using the four twelve point capscrews. Torque the capscrews to the level specified for the appropriate sized capscrew into aluminum threads. See the torque specifications in Description and Specifications.

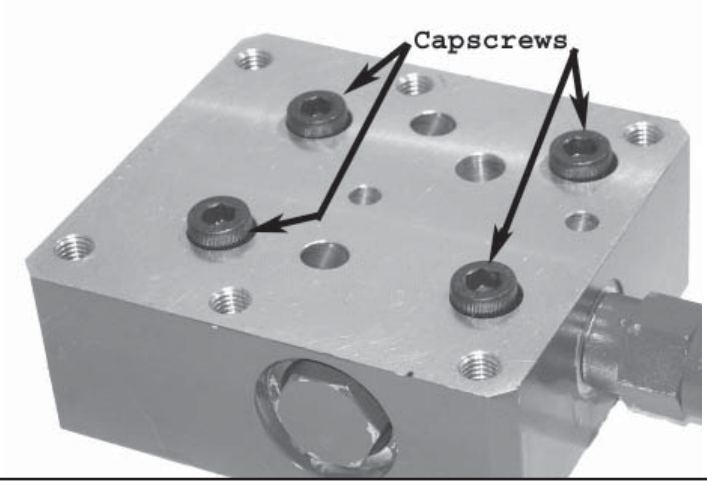


Figure 84. Install Regulator Valve Body to Transmission

4. Install a new gasket, and the Top Valve Body Assembly on the Main Regulator Valve Assembly, using six M10-1.50 x 70 hex head capscrews, and torque to 46 Nm (34 Ft-lb).

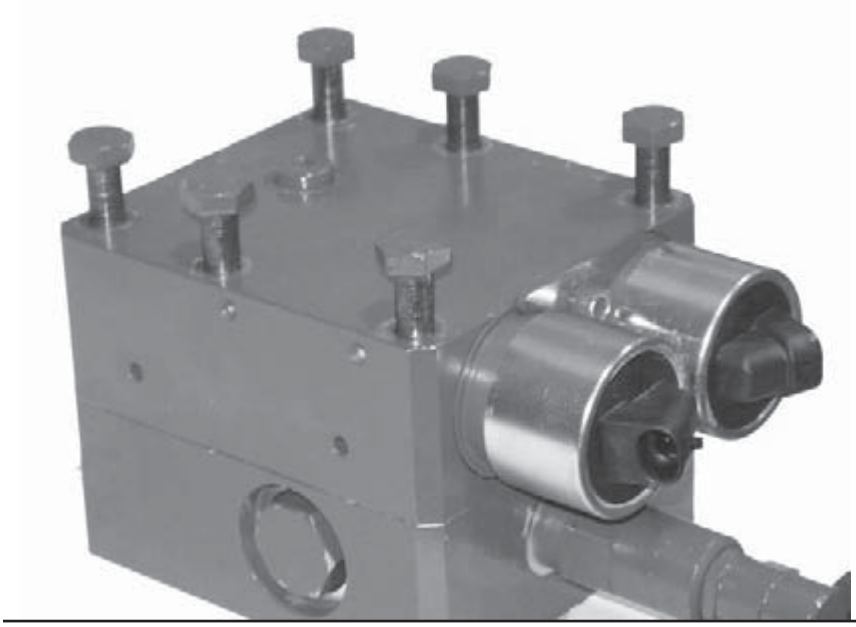


Figure 85. Install Top Valve Body onto Regulator Valve Assembly

5. Install the Electronic Profile or E-Troll Module on the top Valve Body, and torque the four M6-1.0 capscrews to 9.5 Nm (7 Ft-lb).

Figure 86. Place Profile or E-Troll Module onto Valve and tighten screws

6. Connect the electrical wires to the proportional valves, and connect any other wires that were removed during disassembly.

Adjustment of Main Pressure

Valve Assembly 1020729: It is recommended that following the servicing of the GP Valve Assembly off of the transmission that a procedure be followed to ensure the flushing of oil through the valve assembly, followed by adjustment of the main pressure.

1. Install a main pressure gauge into the port on top of the Top Valve body.

2. Remove protective cover cap located at the end of the cartridge. This will expose a 1/4" hex head adjustment stem. Loosen the jam nut on the stem.

Figure 87. Pilot Relief Valve Assembly

3. Turn this adjustment stem counterclockwise until it reaches a positive stop. This allows the engine/transmission to be started and flush any debris past the relief valve.

   Note: This must be done with the transmission in Neutral.

4. Start engine with controls in neutral. Main pressure should be approximately 100 psi or less. Allow the fluid to flush the valve for approximately 1 minute.

5. Turn the 1/4" hex head adjustment stem clockwise to achieve the main pressure setting. A helpful practice is to turn the adjustment stem slightly beyond the desired setting (approximately 5 psi) and then adjust for the target pressure. This aids in reducing variance in pressure setting due to torsional wind-up of the spring.
   Note: If main pressure is to be set with cold oil, adjust the main pressure approximately 5 to 10 psi higher than the desired value with hot oil.

6. Tighten the jam nut to a torque of 20 Nm (15 Ft-lb), install the protective cap, and torque it to 14 Nm (10 Ft-lb)

Valve Assembly 1020729:

1. Install a main pressure gauge into the port on top of the Top Valve body.

2. Remove protective cover cap located at the end of the adjusting stem. This will expose a slotted adjustment stem. Loosen the jam nut on the stem.

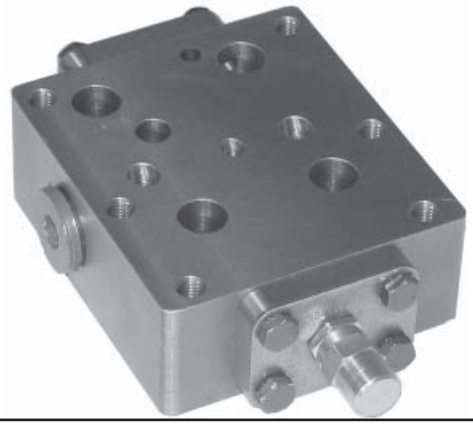


Figure 88. Main Pressure Regulating Valve Assembly 1021658

3. Start engine with controls in neutral.

   Note: This must be done with the transmission in Neutral.

4. Turn the slotted adjustment stem clockwise to achieve the main pressure setting. See the specifications in Description and Specifications.

5. Tighten the jam nut to a torque of 20 Nm (15 Ft-lb), install the protective cap, and torque it to 14 Nm (10 Ft-lb)

Installation

Prior to Installation

⚠ CAUTION

Most Twin Disc products mount directly onto the flywheel of the engine, or are attached to the flywheel through external shafting or adapters. Flywheel-to-driven component interference is possible due to mismatch of components or other reasons. Therefore, engine crankshaft endplay as well as flywheel alignment checks must be made before the driven component is installed.

After installation of the driven component, the crankshaft endplay should be measured again. The endplay at the second measurement should be the same as the first. A difference in these two endplay measurements could be an indication of interference. Consequently, the driven component should be removed and the source of interference found and corrected.

Twin Disc will not be responsible for system damage caused by engine to Twin Disc component interference regardless of the cause of interference. This engine crankshaft endplay check is considered mandatory.

The transmission housing flange and pilot, the engine flywheel and the flywheel housing must be checked for trueness. Clean the engine flywheel and flywheel housing mounting surfaces thoroughly before any measurements are made.

Note: To isolate engine vibration and prevent transferring it to the hull through the propeller shaft, the distance from the marine gear output flange to a fixed stuffing box or the first fixed bearing must be a minimum of 20 times the shaft diameter. If the distance is less than this, a flexible coupling may be necessary to isolate the engine vibration.

Alignment (also reference SAE J-1033 and J-617)

1. Bolt a thousandths increment dial indicator or gauge to the engine flywheel so that the indicator is perpendicular to the face of the engine flywheel housing, and the indicator stem is riding on the face of the flange.

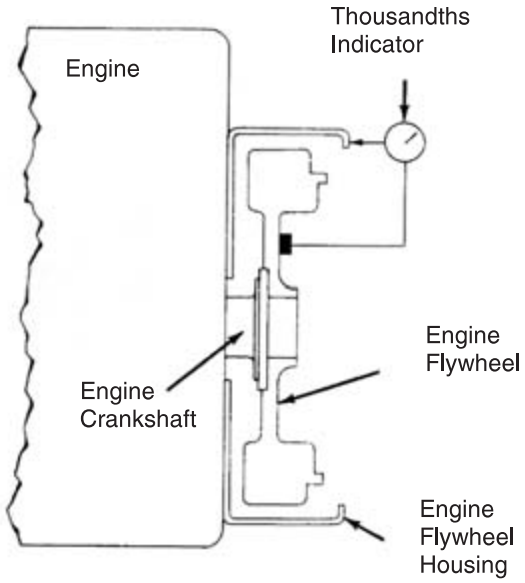


Figure 89. Checking Flywheel Housing Flange for Deviations

2. Rotate the engine flywheel, always keeping a thrust in the same direction, and note the face deviation of the engine flywheel-housing flange. The face deviation must not exceed the figures given in Table 14.

Table 14. Total Indicator Readings for Engine Flywheel Housing Flange

SAE Housing Number	Face Deviations and Bore Eccentricity mm (in)
00	0.48 (0.019)
0	0.41 (0.016)
1/2	0.36 (0.014)
1	0.30 (0.012)
2	0.28 (0.011)

3. With the indicator mounted as in the previous paragraph, adjust the indicator stem so that it will ride on the bore of the engine flywheel housing.

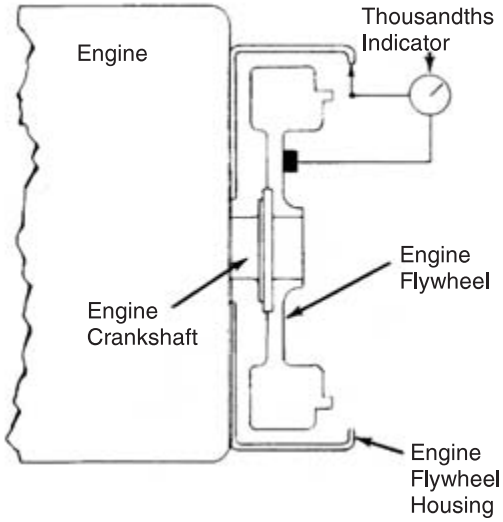


Figure 90. Checking Flywheel Housing Bore Eccentricity

4. Rotate the engine flywheel and note the bore eccentricity of the engine flywheel-housing bore. See the previous Table for allowable tolerances.

5. Bolt a thousandths dial indicator or gauge to the engine flywheel housing so that the indicator is perpendicular to the engine flywheel, and the indicator tip is riding on the inner face of the flywheel. Rotate the flywheel. The variation of the face runout of the surface to which the driving ring is bolted should not exceed 0.013 mm (0.0005 in) per inch of diameter.

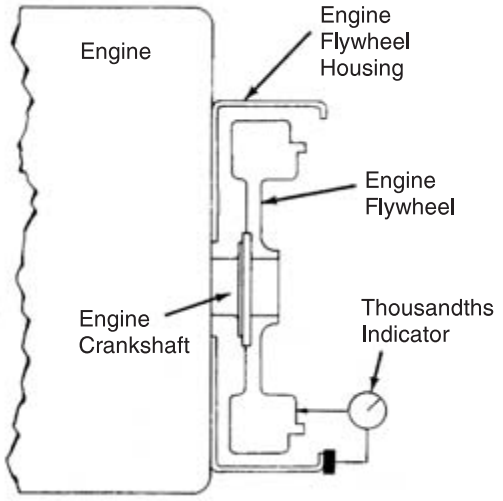


Figure 91. Checking the Flywheel Face Runout

6. With the indicator mounted as in the paragraph above, adjust the indicator tip so that it will ride on the driving ring pilot bore of the engine flywheel. Rotate the flywheel. The driving ring pilot bore eccentricity of the engine flywheel should not exceed 0.13 mm (0.005 in) maximum total indicator reading. Thrust on the flywheel should be in one direction at all times to obtain a correct reading.

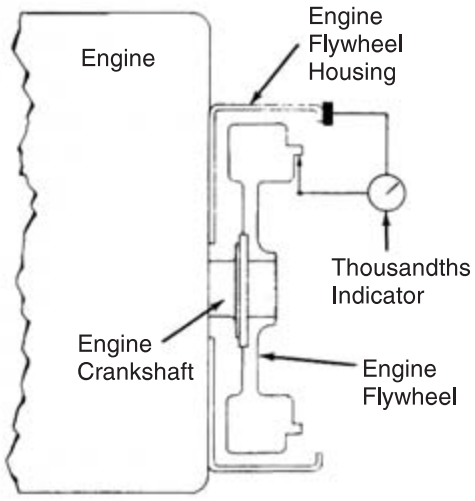


Figure 92. Checking the Flywheel Pilot Ring Bore Eccentricity

Alignment

Propeller Shaft

Before any attempt to align the engine and gearbox to the propeller shaft, proper alignment of the propeller shaft must be determined. This includes alignment of the propeller shaft through all struts and intermediate bearings. Failure to properly align the propeller shaft may result in premature wear on bearings, vibrations, or possible damage to other components.

If the length of the shaft from the last support bearing to the gearbox is excessive or a flexible stuffing box is used, the shaft must be centered prior to engine and gearbox to propeller shaft alignment.

Engine and Marine Transmission

Proper alignment of an engine and marine unit is critical, both during the initial installation and at frequent intervals during the life of the boat. It is rather common for a boat to change its form with various loads and with age. Engine and shaft alignment can also change on a boat due to varying loads and the boat's age. The following steps may be taken to secure proper marine transmission alignment.

When reinstalling a marine gear after a repair, or when installing a new marine gear to an engine already mounted in the bed rails, the flywheel housing should be checked for deflection using the following procedure:

Install the mounting brackets on the side mounting pads of the marine gear. Install the driving ring on the engine flywheel. Bolt an indicator to the engine block and set the indicator stem on the engine flywheel housing

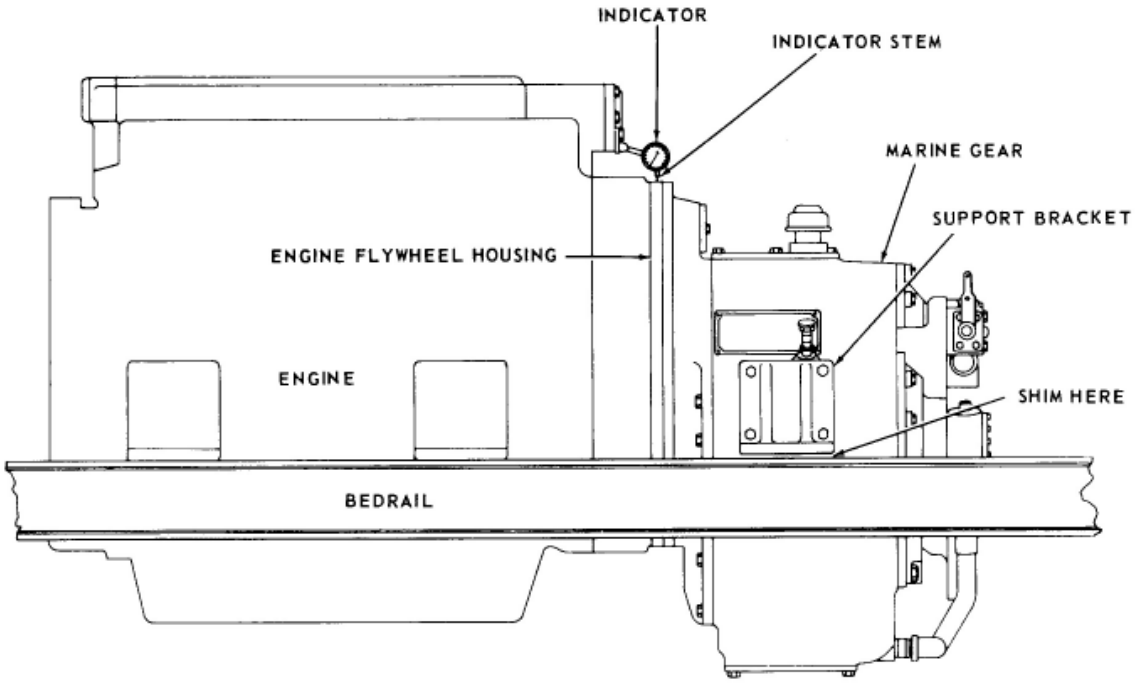


Figure 93. Marine Gear Alignment

Set the indicator gauge at zero (0). Lift the marine gear with a hoist, or other suitable means, and place the unit in position against the engine flywheel housing. Secure the flange of the marine gear main housing to the engine flywheel housing. Use a feeler gauge between each mounting bracket and engine bed rail. Add shims between the brackets and bed rails to equal the feeler gauge readings. Carefully release the lifting force on the marine gear while observing the indicator. The indicator gauge must remain steady at the zero mark. Torque the bed bolts to the proper rating. If the reading moves from zero, lift the marine gear and insert additional shims. Continue this procedure until the marine gear is completely at rest on the bed rails and the gauge maintains a steady zero reading. After obtaining the correct zero reading, indicating no distortion of the engine flywheel housing, secure the mounting brackets to the engine bed rails. Before securing the mounting brackets to the engine bed rails, the propeller shaft should be checked for alignment.

Note: The transmission output flange and companion flange bolts must be torqued to the proper value as identified in Description and Specifications.

Engine and Marine Transmission Alignment to Propeller Shaft

⚠ CAUTION

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and transmission must be used. Failure to do so may result in damage to the transmission or the engine flywheel housing.

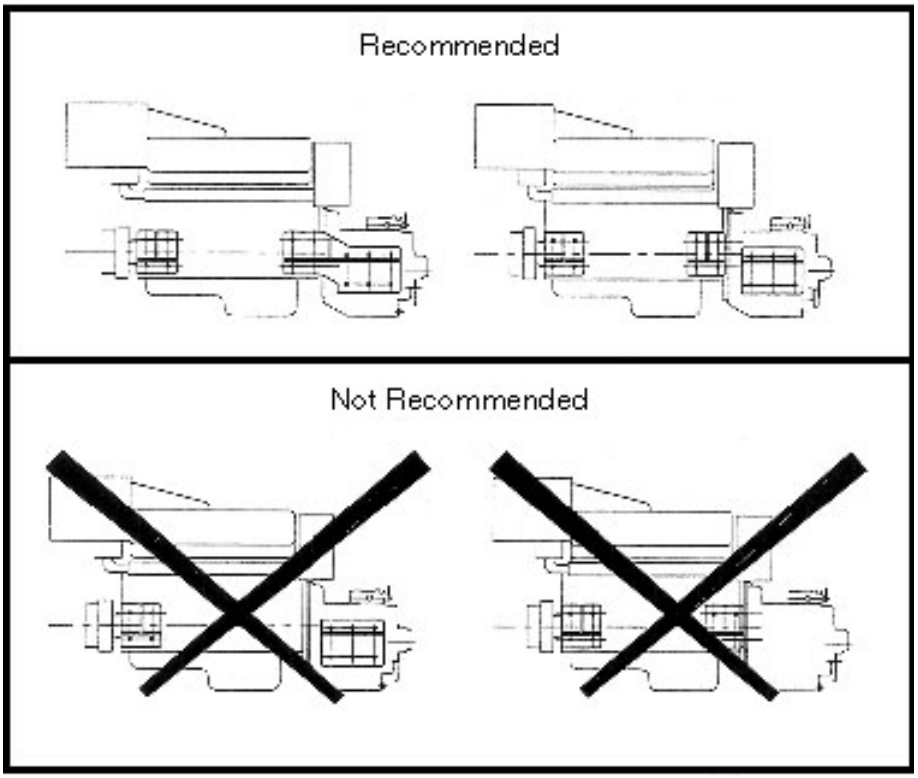


Figure 94. Transmission Mounting Configurations

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and the transmission must be used. Failure to do so may result in damage to the transmission.

It is important to align the engine and transmission only when the boat is afloat, and NOT in dry-dock. During this alignment period, it is also advisable to fill the fuel tanks and load the boat in the typical manner that it is to be used. Some boats are built with flexibility and may change shape as the loading varies.

When a heavy boat is dry-docked, it naturally undergoes some bending. Therefore, it is always good practice to unbolt the marine transmission coupling to prevent bending of the shaft.

With the engine and transmission in position on the engine bed, arrangements must be made to have a controlled lifting or lowering of each of the four corners of the engine. If threaded holes are provided in each of the engine mounts, jacking screws can be used in them. The engine can be raised by screwing down, or lowered by backing off on the jacking screws to obtain the desired adjustment.

Steel plates must be inserted under the jacking screws so that the bolts will not damage the engine bed. Lifting can also be accomplished by the use of chain hoists or properly placed jacks. Adjustable shims also are available and can simplify the alignment process, particularly for future realignment.

It may also be necessary to move the engine and transmission to one side or the other on the engine bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation. At the same time, a straight edge is laid across the edges of the flanges at the top and side to check the parallel alignment of the coupling edges.

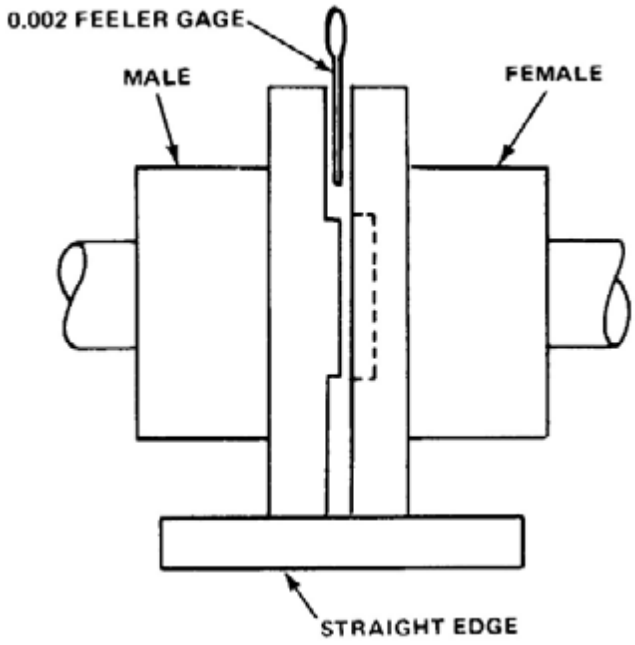


Figure 95. Checking Parallel Alignment of the Coupling

As the engine and marine transmission come into their aligned position, it will be possible to mate the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. Place a 0.05 mm (0.002 in) feeler gauge between the flanges of the coupling. Move (slide) the feeler gauge completely around the coupling. Rotate the marine transmission flange coupling in 90 degree increments, and move the feeler gauge around the flange in each successive position. The feeler gauge will fit snugly, with the same tension, all around the flange coupling in all four positions if the alignment is correct.

If the alignment varies during rotation, additional alignment is necessary, or the marine transmission and shaft couplings should be checked for proper face runout. Runout must not exceed 0.10 mm (0.004 in). Excessive face runout on the marine transmission output flange can usually be corrected by repositioning the coupling on its spline or taper. Excessive shaft coupling runout is usually due to inaccuracy of the taper fit or key to keyway interference. The optimum relative mating location will be where the measured runout dimensions of the transmission flange and the shaft coupling flange compliment each other to result in the least relative out of true parallel measurement.

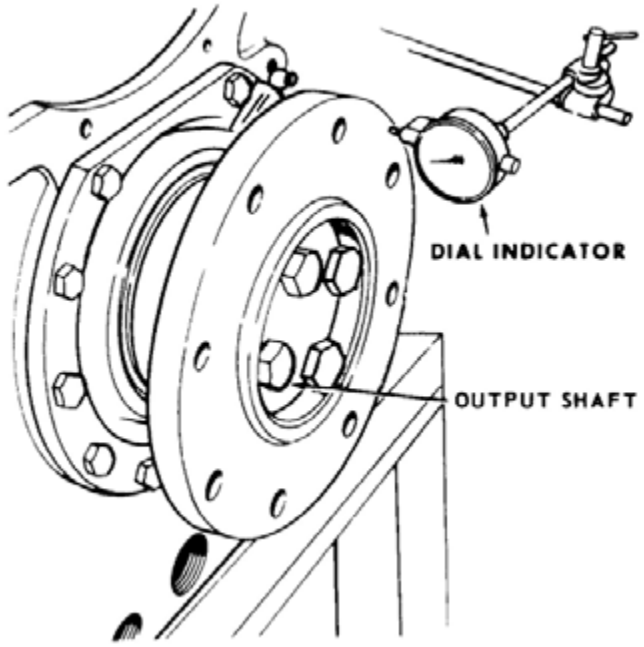


Figure 96. Checking Output Flange Face Runout

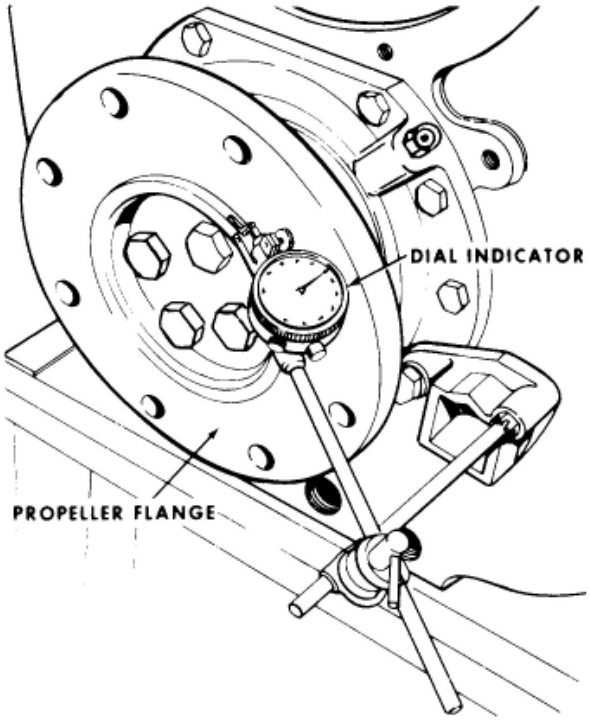


Figure 97. Checking Output Flange Pilot Eccentricity

Some boats are not structurally rigid and some carry their load in such a way that they will “hog” or go out of normal shape with every loading and unloading. Where this condition exists, it important to apply common sense alignment techniques to minimize the potential damage to any of the components.

During the process of securing final alignment, it may be necessary to shift the engine many times. When the final alignment is accomplished, mark and drill the holes for the lag studs or locating dowel pins. Then with final alignment secured, make up the necessary poured, steel, or hardwood shims, and fasten the engine and transmission in place. Then recheck the alignment, and if satisfactory, bolt the coupling together.

There are many types of flexible couplings in the market today that solve a variety of problems:

- ❑ Couplings to reduce noise and vibration.
- ❑ Couplings to allow a permanent angular misalignment.
- ❑ Couplings that allow engines to be flexibly mounted and take out the momentary misalignment.

In some cases, the proper alignment of these couplings requires an accuracy equal to that of rigid couplings. Always use the alignment procedures recommended by the coupling manufacturer.

Electrical Controls Installation

All electrical wires and connectors must be adequately supported to prevent rubbing, chafing, or distress from relative movement. All electrical connectors must be tight and free from corrosion. It is strongly recommended that the Control Harnesses and Wiring guidelines be followed to ensure proper installation of all wiring.

Control Harnesses and Wiring guidelines

Install all control wires and harnesses as follows:

1. The connector end of the control wire or harness must be secured to its own support six inches back from each connector. The wire or harness must be secured at 18 inch intervals to its own frame supports between the wire or harness ends.
2. Keep wire or harness away from hot surfaces, moving parts and oil locations.
3. Attach wire or harness to machine, making the connector the highest point of the wire. If not possible, install wire or harness with drip loop.
4. Protect wire or harness with grommet, loom or flex guard at any *rub* point, particularly when passing a sheet metal hole.
5. Locate wire or harness away from potential hazards. For example, a screw cutting through the jacket and shorting a conductor to the chassis, welding, drilling, etc.

6. Prevent the wire from becoming a step or hand rail.

7. When mating connectors, make sure they will mate properly. Coat pins and sockets only with dielectric compound to seal out moisture and corrosive substances (Twin Disc part number MA890 or Dow 4 Compound.) Locate and use the connector orientation key.

8. Circular connectors must be hand tightened.

9. Wire or harness bend radius must not be less than twenty times the wire or harness diameter.

10. Avoid twisting or winding the wire or harness along its axis during installation or removal.

11. Whenever mating connectors, always inspect each for damage or defects. For example: bent pins, pushed-back sockets, broken keys, etc.

12. Check that sure-seal connectors have clip/clamps in place.

13. Check the wire or harness tie downs. Keep wires securely fastened to vessel frame.

14. Check the condition of the wire or harness at any *rub* point and wherever the wire or harness passes through a sheet metal hole.

15. Check wire or harness for cracks, effects of vibration, abrasion, brittleness or abuse.

Wiring Connections

General

The vessel wiring for the Profile or E-Troll Module must be of sufficient size to prevent excessive voltage drop (no greater than 0.5 Vdc) between the battery connections (positive voltage and ground) and the Profile or E-Troll Module. The modules operate from nominal 12 VDC or 24 VDC batteries. The battery power connection must be protected by an electrical over-current protection component (fuse or circuit breaker) as required by the vessel's approval agency. The minimum current capacity should be 5 amps.

WARNING

Do not connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

The customer supplied selector switches for each of the transmission clutches and for troll (if equipped) must be connected directly to the wires of the Profile or E-Troll Module, and connected to the power source as shown in the table that follows. No other electrical loads should be connected to this circuit.

Make the following Connections

The following power connection chart lists the possible configurations for connecting Electronic Profile or E-Troll Module to the power source for the three possible wiring options.

- ☐ Option 1 connections are used when the Profile or E-Troll Module is connected to non-electronic lever heads.
- ☐ Option 2 connections are used when the Profile or E-Troll Module is connected to electronic gear controllers.
- ☐ Option 3 connections are used when the Profile or E-Troll Module is connected to electronic control solenoid driver outputs. The electronic control's Solenoid A and B returns or negative signals should be connected together and connected to the E-Troll module return (if equipped). Electronic control solenoid drivers must have their solenoid return internally connected directly to ground. If not, the Profile or E-Troll Module must be interfaced to the electronic control with relays.

Table 15. Module Power Connection Chart

Wire	Wiring Option 1	Wiring Option 2	Wiring Option 3
Troll Enable Switch Return (if equipped)	Connect to the negative terminal of the engine battery.	Connect to the same ground point used by the gear controller or the engine control.	Connect to the same point as the control's power ground signal.
Solenoid B Switch	Connect to the positive terminal of the engine battery through the switch contacts used to energize Solenoid B.	Connect to the output in the gear controller that is used to energize Solenoid B.	Connect to the control's Solenoid B positive driver output.
Solenoid return	Connect to the negative terminal of the engine battery.	Connect to the same ground point used by the gear controller or the engine control.	Connect to the control's solenoid negative output circuit.
Solenoid A Switch	Connect to the positive terminal of the engine battery through the switch contacts used to energize Solenoid A.	Connect to the output in the gear controller that is used to energize Solenoid A	Connect to the control's Solenoid A positive driver output.

- ☐ The customer supplied normally closed not in neutral relay must be located in a position to not be affected by vibration. The coil must have a 200 ma maximum current draw. The coil must be connected to the two "not in neutral" wires of the Profile Generator.
- ☐ The contacts of the manual direction control switch (closed in neutral) must be wired in series with the energizing coil of the not in neutral relay.
- ☐ Plug the appropriate connectors from the Profile Generator into the appropriate Proportional Valves.
- ☐ Plug the appropriate connectors from the Profile Generator into the Engine Speed sensor and the Propeller speed sensor (if equipped).
- ☐ When the "not in neutral" circuit is not used, insulate and secure the blue and black wires.

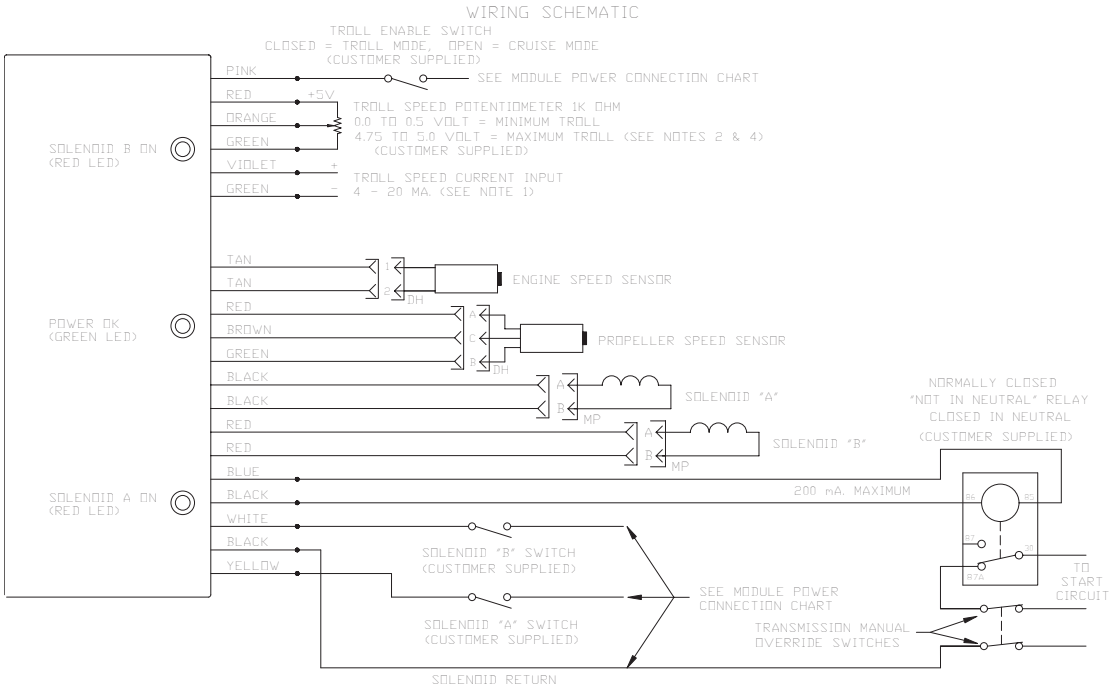


Figure 98. E-Troll Wiring Diagram

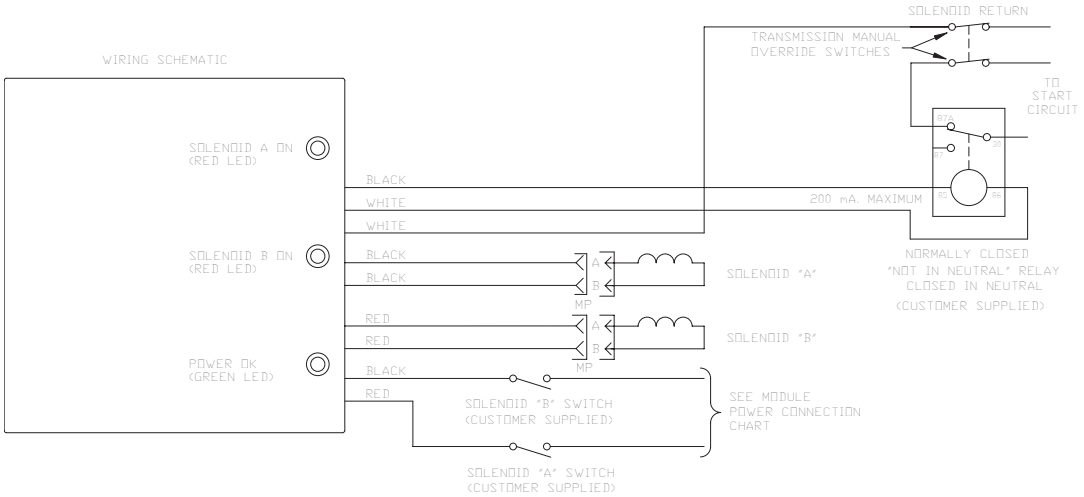


Figure 99. Profile Module Wiring Diagram

Final Checks

Be sure the transmission is filled with oil before starting. See Description and Specifications and Preventative Maintenance for proper oil and filling procedure.

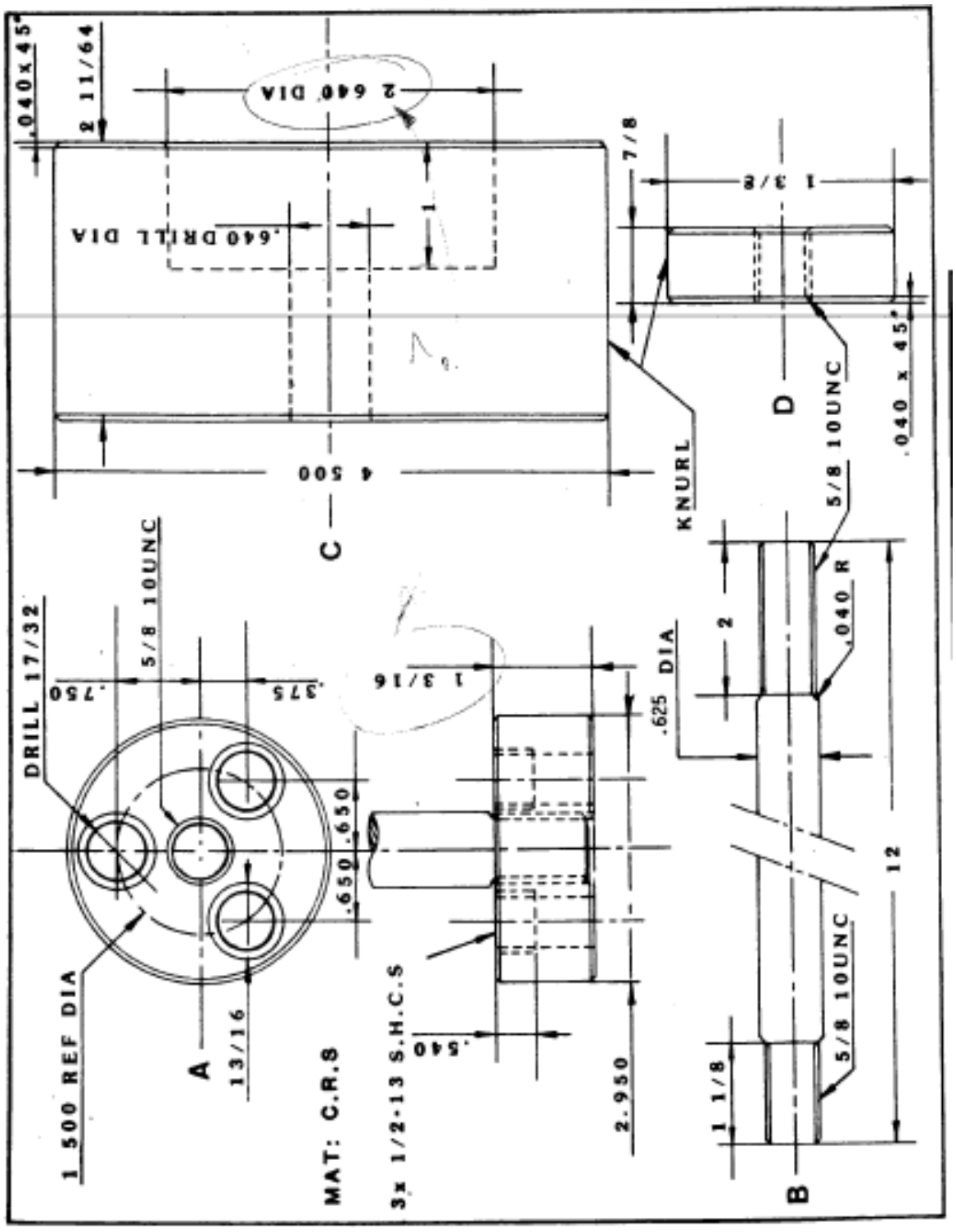
Special Tools

List of Special Tools

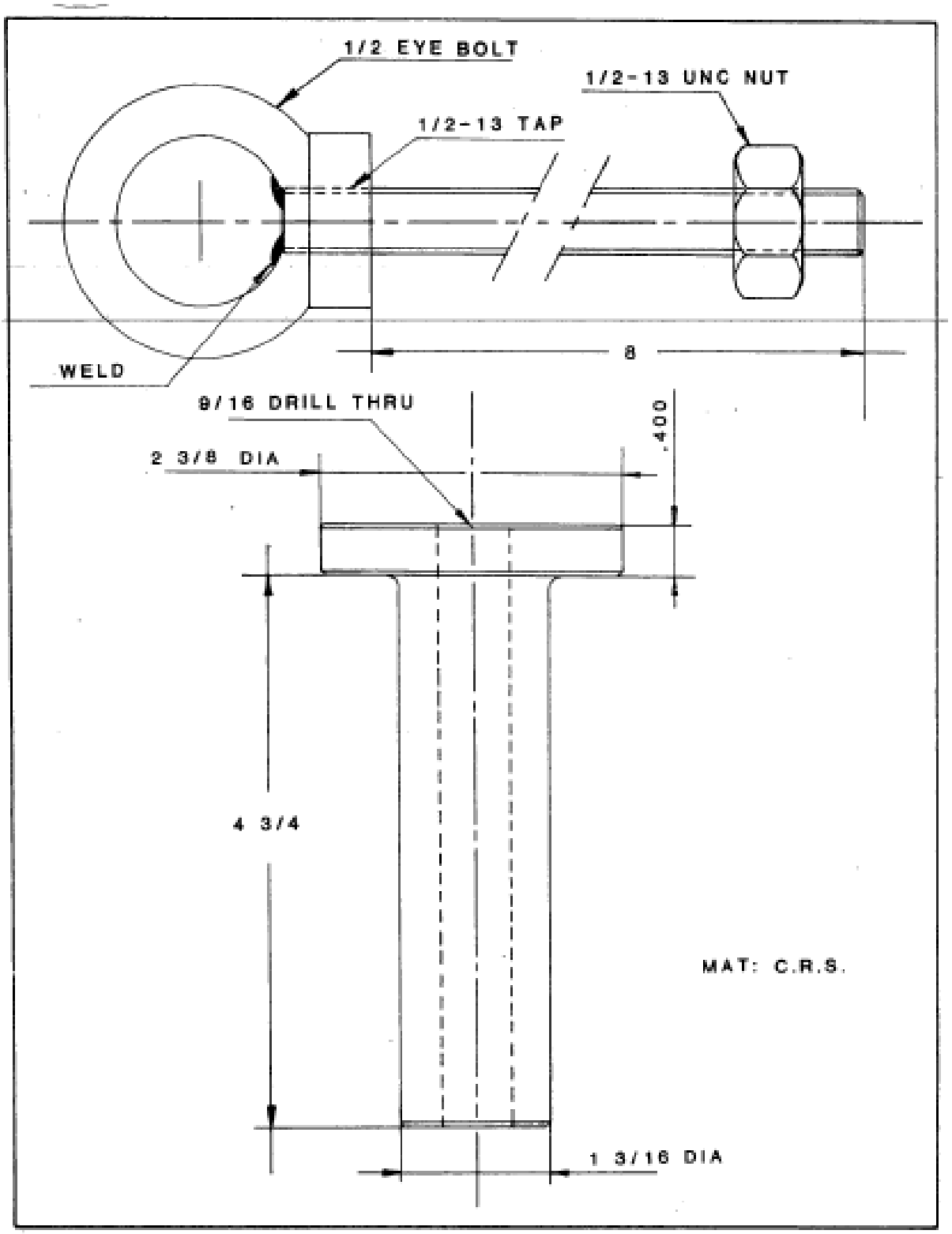
The following pages include the special tool drawings that are specific to these models. The special tool drawings included are listed below and continue on the following page.

- ❑ TD-300389 Output Flange Puller
- ❑ TD-300388 Endplay Adjustment Fixture
- ❑ T18503 Spring Compression Tool
- ❑ 1020117 “S” Valve Test Body
- ❑ B2408AL “S” Valve Test Procedure

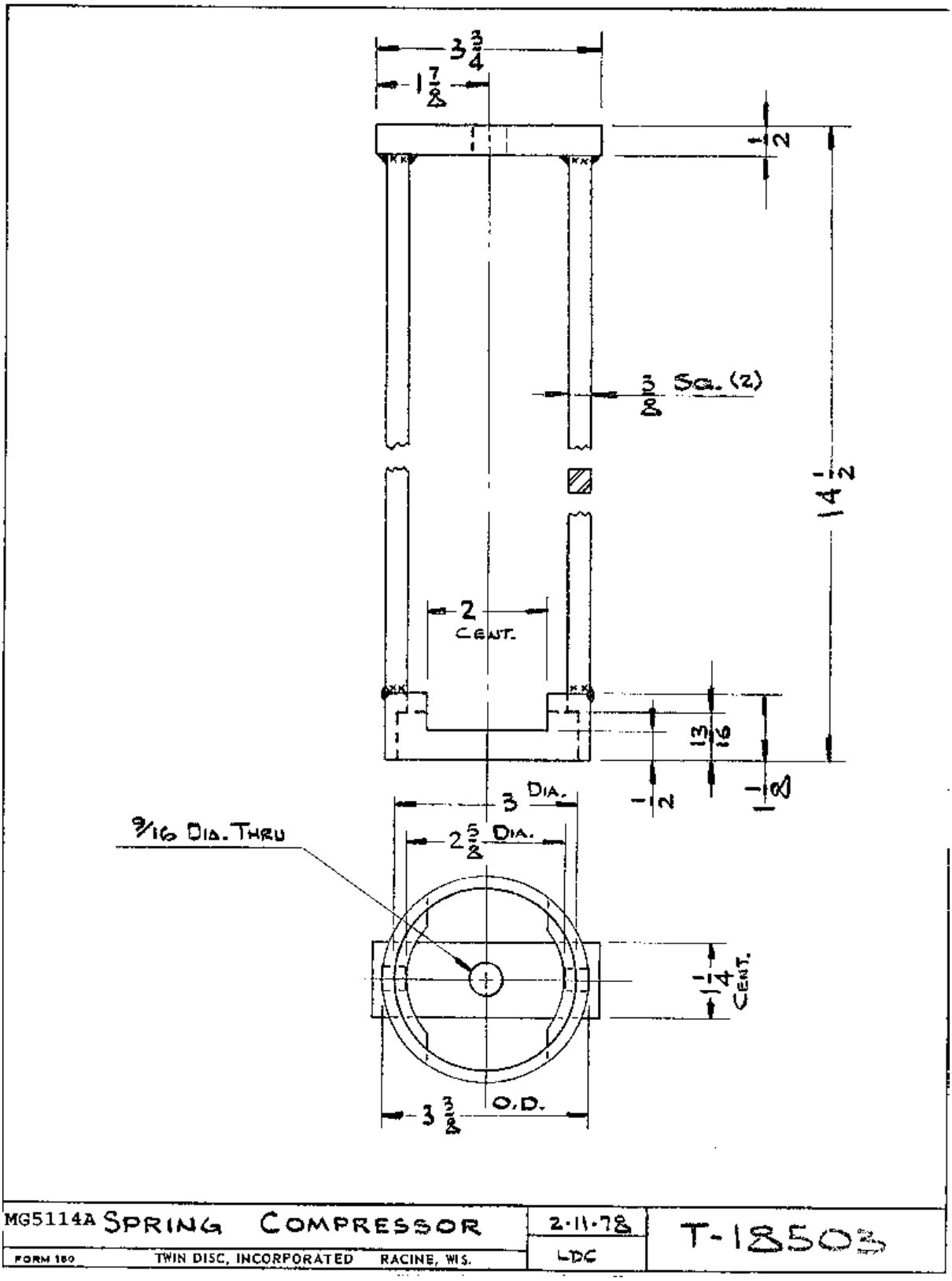
TD-300389 Output Flange Puller

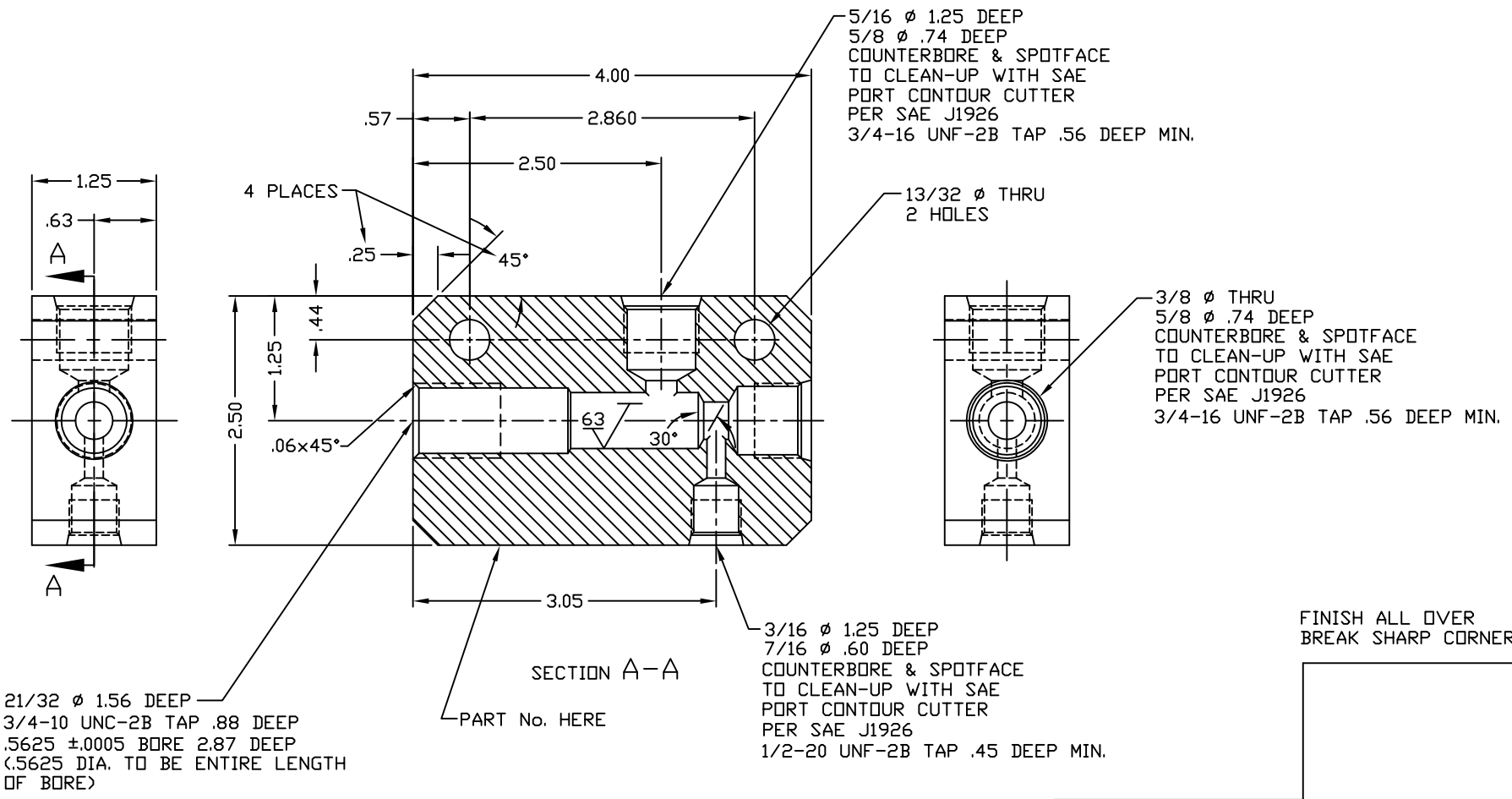


TD-300388 Endplay Adjustment Fixture



T-18503 Spring Compression Tool





REV	CH. NO.	DATE	REV	CH. NO.	DATE

SIMILAR TO

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MATERIAL: STEEL PER S396-1

HEAT TREAT: ———

SURFACE TREATMENT: ———

WEIGHT LBS. | WR² LBS. IN²

FIRST USE
ASSY. 1020116
MODEL MG5114A

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS
X.X ±0.030
X.XX ±0.010
X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

NAME: BODY, CARTRIDGE VALVE TEST

DATE: 1-25-01
SCALE: 1=1
DRN.: JM
CHK.: BJE/ALC
APPD.: BJE/ALC

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1020117

SHEET 1 OF 1 | REV ___

REF. B2408AL

I. Testing of PX11801 Cartridge Valve Assembly

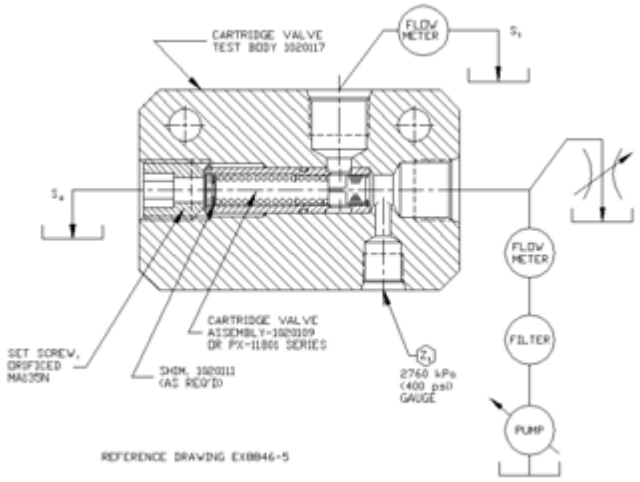
1. VALVE ASSEMBLY TEST

A. For use when valve only is to be tested (at time of unit overhaul)
B. This valve must always be tested as outlined below for all uses. The valve is to pass all of these checks and tests before being approved for shipment.
C. Please follow applicable routing instructions carefully.
D. Record all data.

2. MINIMUM EQUIPMENT SPECIFICATIONS

A. Oil flow of 19 L/min (5 gpm) capacity with bypass of 2760 kPa (500 psi).
B. Oil viscosity of 90 - 110 SUS (18.2 - 20.6 cS).
C. Adapter plate 1020117 for proper mounting of cartridge valve to:
   1] Allow leakage oil at S_1 and S_2 to return to sump.
   2] Provide means to measure flow rates at S_1 and S_2.
   3] Provide 2760 kPa (400 psi) pressure gauge at Z_1.

3. VALVE TEST SET-UP



II. PX-11801 SERIES CARTRIDGE VALVE PRODUCTION TEST SHEET

1. Using a non-marring technique, mark the sequence valve with a serial number.
2. With the pressure at Z_1 set **1207 kPa (175 psi**), Leakage at S_1 and S_2 to be no more than 1.0 L/min (.25 gpm). Record leakage flow rate at S_1 and S_2.
3. Slowly increase pressure at Z_1 until flow rate at S_1 is 2.3 L/min (.6 gpm). Add or remove the 1020111 shims as necessary to achieve the minimum sequence pressure of **1344 ± 34 kPa (195 ± 5 psi) for MGX5114A,** and a flow rate of S_1 of 2.3 L/min (.6 gpm). Record final pressure at Z_1 with flow rate of 2.3 L/min (.6 gpm) at S_1.
4. Increase flow rate at S_1 to 3.8 L/min (1.0 gpm). Pressure at Z_1 to be within range charted in II.2. Record final pressure at Z_1 with flow rate of 3.8 L/min (1.0 gpm) at S_1.

III. PX-11801 SERIES CARTRIDGE VALVE PRODUCTION TEST SHEET

1. Sequence Valve Serial Number:_____
2. Leakage at S_1 with pressure at Z_1 set at charted pressure given in section II. 2.:_____
3. Leakage at S_2 with pressure at Z_1 set at charted pressure given in section II. 2.:_____
4. Pressure at Z_1 with flow rate of 2.3 L/min (.6 gpm) at S_1:_____
5. Pressure at Z_1 with flow rate of 3.8 L/min (1.0 gpm) at S_1:_____

Tester:_____ Date:_____

Illustrations

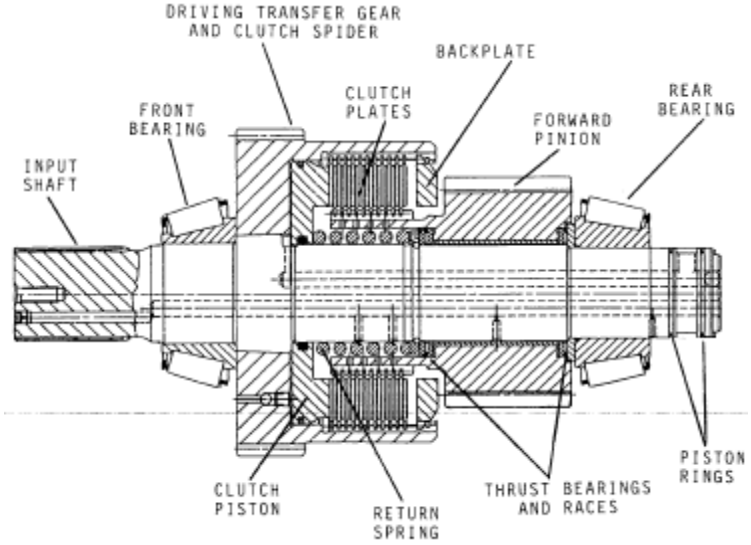
List of Illustrations

The following pages include illustrations that are specific to this model. The illustrations included are listed below.

Note: Any part numbers listed in the following illustrations are for reference only. Please refer to your bill of material for part numbers specific to your model.

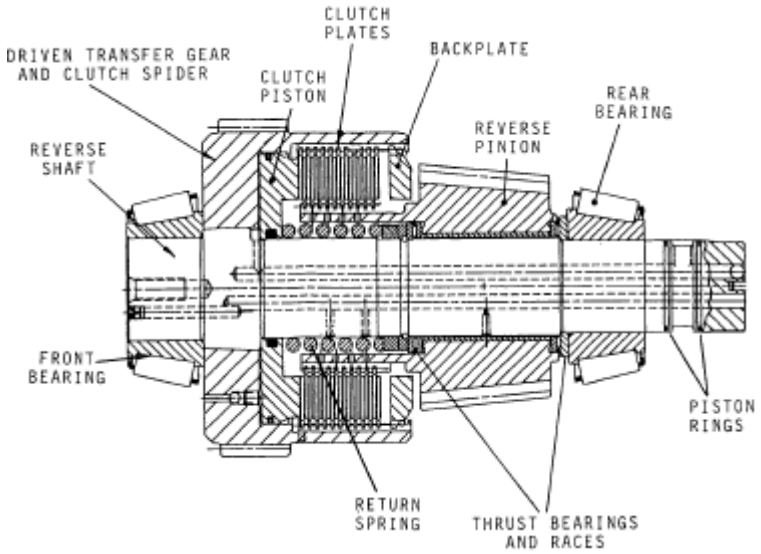
- ❑ Forward Clutch Shaft - Cross Section
- ❑ Reverse Clutch Shaft -Cross Section
- ❑ “S” Valve - Cross Section
- ❑ Output Shaft - Cross Section
- ❑ Forward Clutch Exploded View
- ❑ Reverse Clutch Exploded View
- ❑ Output Shaft Exploded View

Forward Clutch Shaft - Cross Section



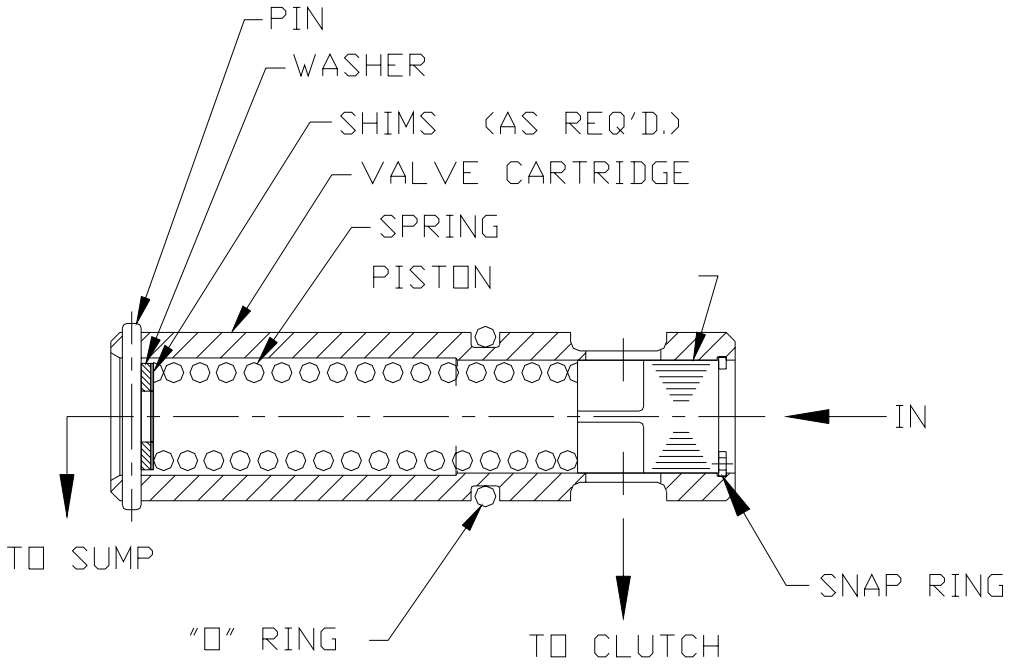
Note: “S” Valve not shown in center of shaft in this Figure

Reverse Clutch Shaft -Cross Section



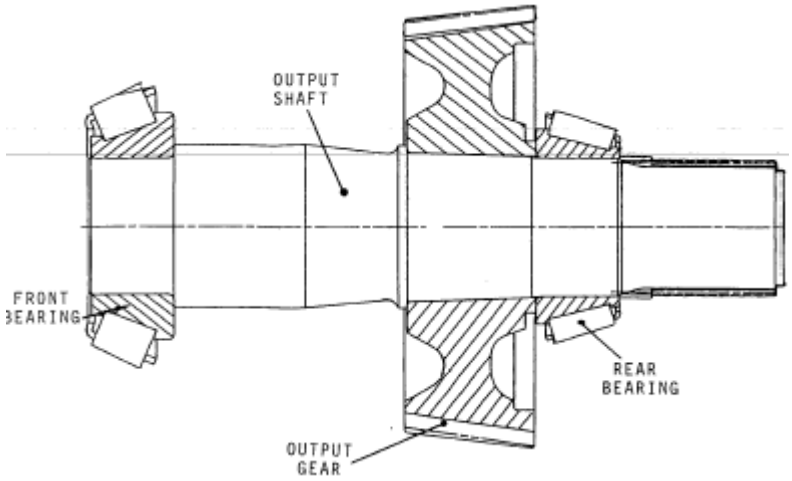
Note: “S” Valve not shown in center of shaft in this Figure

“S” Valve Cross Section



CALIBRATE PER B2408AL
VALVE PRODUCTION TEST
SPECIFICATION
VALVE TO BE SHIMMED
TO CRACK AT 210±5 PSI.
△ PSI/SHIM = 3.75 PSI.

Output Shaft Cross Section

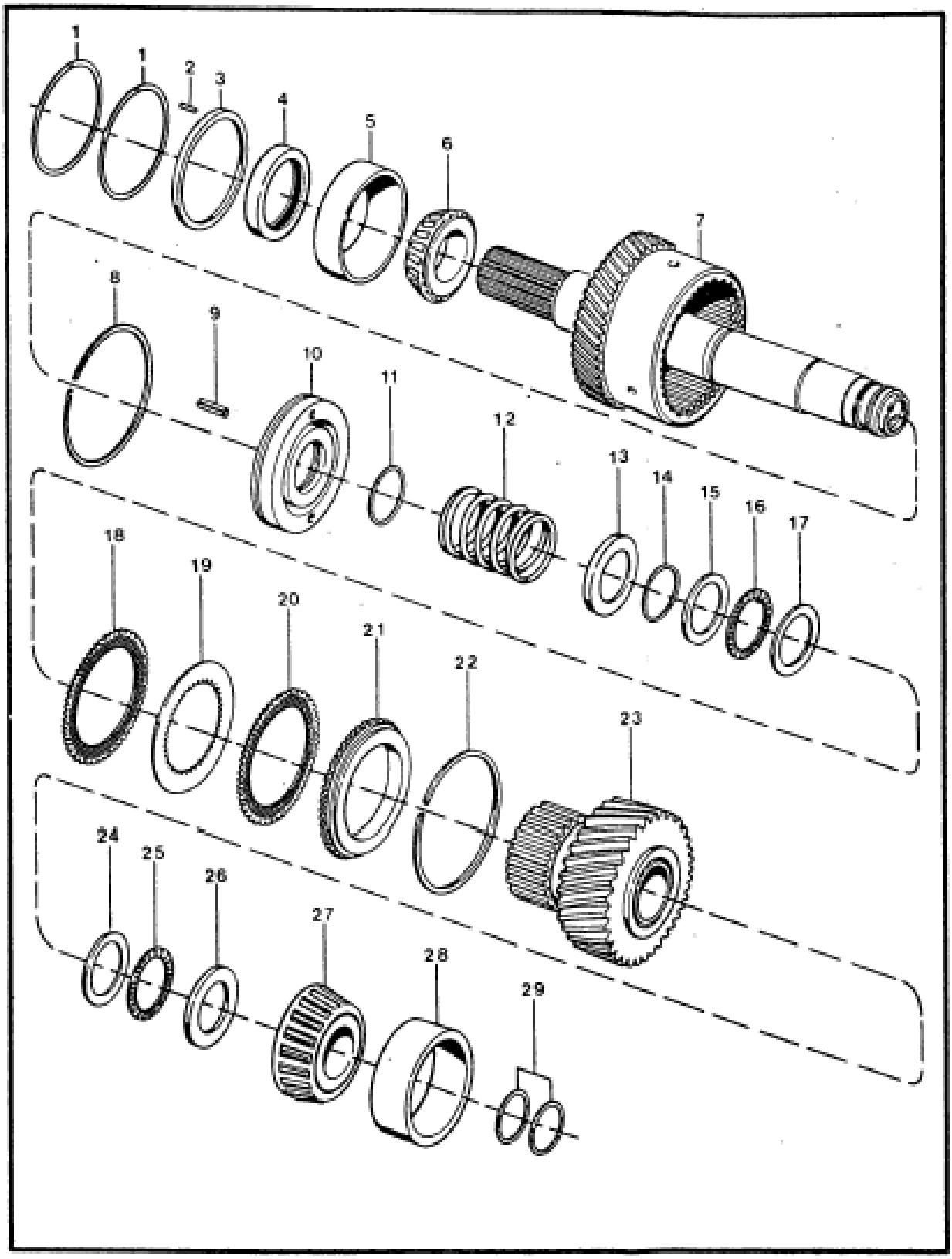


Forward Clutch Exploded View

ITEM	DESCRIPTION	QTY
1	SHIM	A/R
2	ROLLPIN	1
3	SPACER	1
4	SEAL, Oil	1
5	BEARING, Taper Roller, Outer Race	1
6	BEARING, Taper Roller, inner Race	1
7	SHAFT ASSEMBLY, Input	1
8	RING,Piston	1
9	ROLLPIN	(*)
10	PISTON, Clutch	1
11	O-RING	1
12	SPRING, Clutch release	1
13	RETAINER, Spring	1
14	RING, Snap	1
15	RACE, Thrust	1
16	BEARING, Needle Thrust	1
17	RACE, Thrust	1
18	PLATE, Sintered (one side only)	(*)
19	PLATE, Steel	10
20	PLATE, Sintered	11
21	BACKPLATE, Clutch	1
22	RING, Snap	1
23	PINION ASSEMBLY, Forward	1
24	RACE, Thrust	1
25	BEARING, Needle Thrust	1
26	RACE, Thrust	1
27	BEARING, Taper Roller, inner Race	1
28	BEARING, Taper Roller, Outer Race	1
29	PISTON RING	2

(*) NOT APPLICABLE THIS UNIT

Note: “S” Valve not shown in center of shaft in this Figure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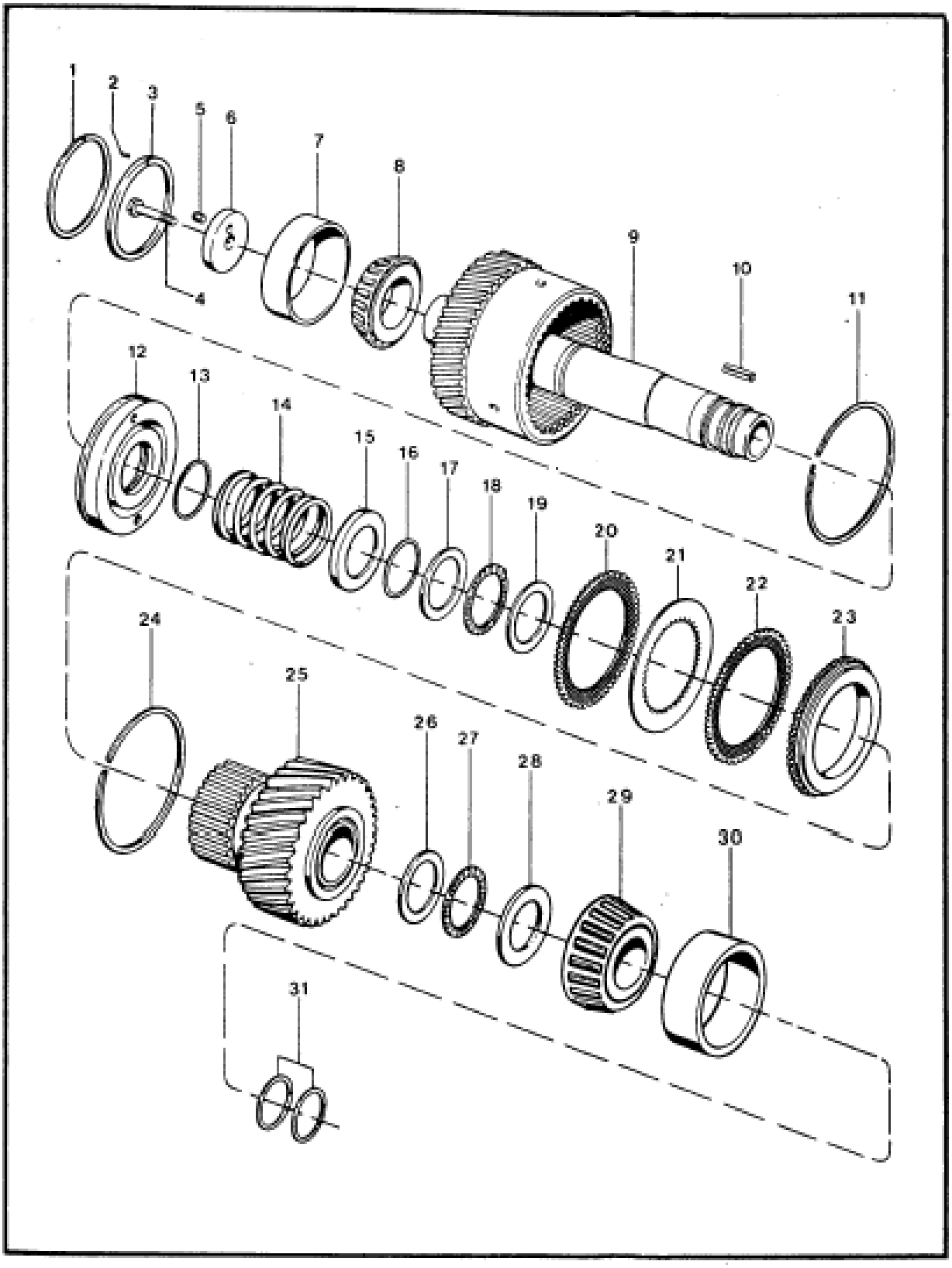
Reverse Clutch Exploded View

ITEM	DESCRIPTION	QTY
1	SHIM	A/R
2	ROLLPIN	1
3	SPACER	1
4	CAPSCREW, Hex-Head	(*)
5	PLUG, Orifice Pipe	1
6	WASHER, Retainer	(*)
7	BEARING, Taper Roller, Outer Race	1
8	BEARING, Taper Roller, inner Race	1
9	SHAFT ASSEMBLY, Input	1
10	ROLLPIN	(*)
11	RING,Piston	1
12	PISTON, Clutch	1
13	O-RING	1
14	SPRING, Clutch release	1
15	RETAINER, Spring	1
16	RING, Snap	1
17	RACE, Thrust	1
18	BEARING, Needle Thrust	1
19	RACE, Thrust	1
20	PLATE, Sintered (one side only)	(*)
21	PLATE, Steel	10
22	PLATE, Sintered	11
23	BACKPLATE, Clutch	1
24	RING, Snap	1
25	PINION ASSEMBLY, Reverse	1
26	RACE, Thrust	1
27	BEARING, Needle Thrust	1
28	RACE, Thrust	1
29	BEARING, Taper Roller, inner Race	1
30	BEARING, Taper Roller, Outer Race	1
31	PISTON RING	2

(*) NOT APPLICABLE THIS UNIT

Note: “S” Valve not shown in center of shaft in this Figure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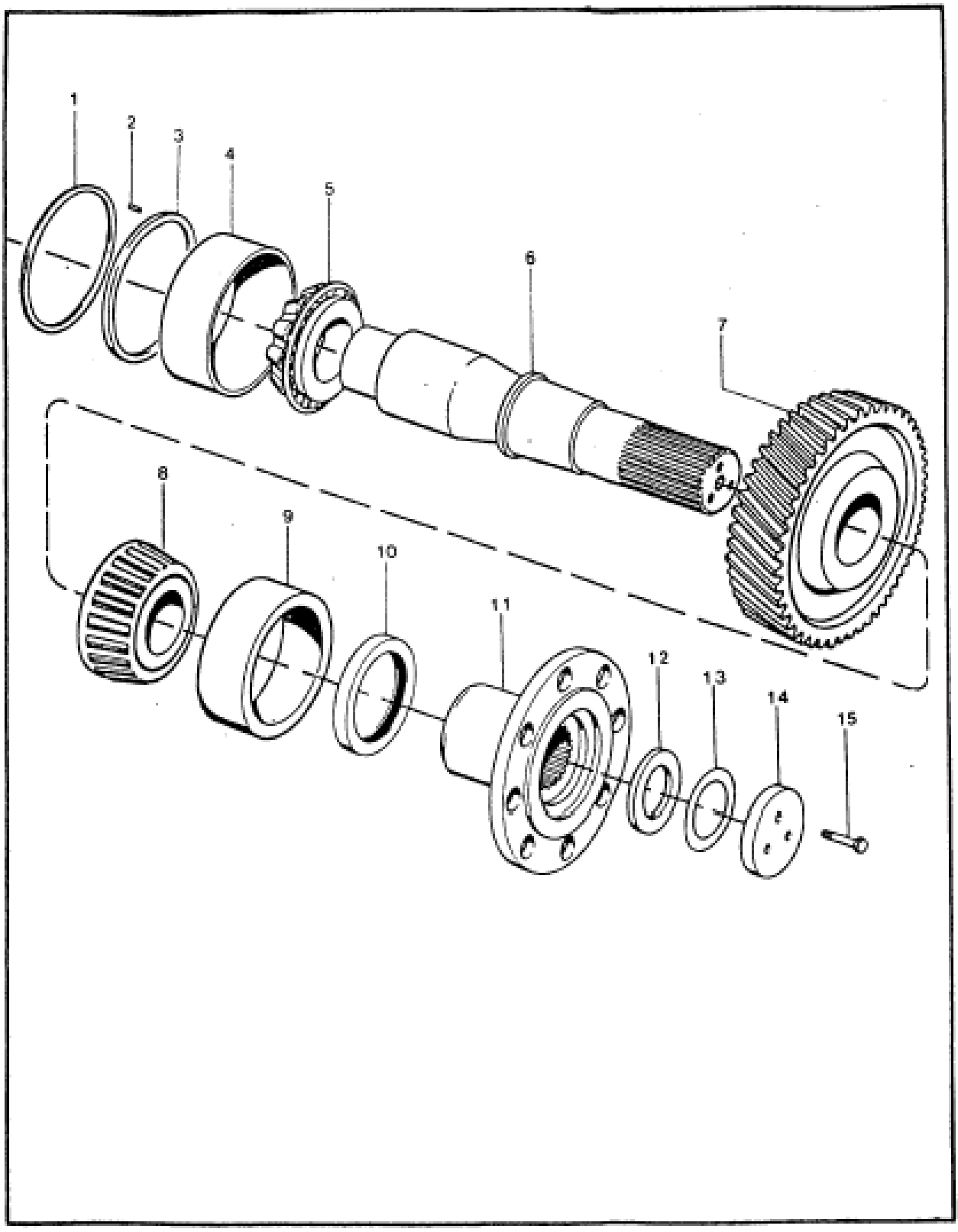
Output Shaft Exploded View

ITEM	DESCRIPTION	QTY
1	SHIM	A/R
2	ROLLPIN	1
3	SPACER	1
4	BEARING, Taper Roller, Outer Race	1
5	BEARING, Taper Roller, inner Race	1
6	SHAFT, Ouput	1
7	GEAR, Output	1
8	BEARING, Taper Roller, inner Race	1
9	BEARING, Taper Roller, Outer Race	1
10	SEAL, Oil	1
11	FLANGE, Output	1
12	RING, Rectangular Rubber	1
13	SHIM	A/R
14	WASHER, Retainer	1
15	CAPSCREW, Hex-Head	3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Engineering Drawings

List of Engineering Drawings

The following pages include the engineering drawings that are specific to these models. The engineering drawings included are listed below .

Note: Any part numbers listed in the following engineering drawings are for reference only. Please refer to your bill of material for part numbers specific to your model.

- ❑ PX 11730 (sheet 1 of 4) Marine transmission Cross Section
- ❑ PX 11730 (sheet 2 of 4) Marine transmission Installation
- ❑ PX 11730 (sheet 3 of 4) Marine transmission Installation
- ❑ PX 11730 (sheet 4 of 4) Marine transmission Mounting Pads
- ❑ 1020729 GP Valve Assembly
- ❑ 1020584 E-Troll Control Module (sheet 1 of 2)
- ❑ 1020586 Profile Control Module (sheet 1 of 2)
- ❑ A7119AD Hydraulic diagram
- ❑ 1021658 GP Valve Assembly

PRIMARY PINION (1 REQUIRED)				SECONDARY PINION (1 REQUIRED)			
ASSEMBLY NUMBER	CONSISTS OF BUSHING M2073CL * AND PINION NO.	NO. TEETH	RATIO	ASSEMBLY NUMBER	CONSISTS OF BUSHING M2073CL * AND PINION NO.	NO. TEETH	RATIO
● PX9727A	* P9727	18	2.50 :1	PX9728A	* P9728	18	2.50 :1
PX11028	* P11028	25	2.04 :1	PX11029	* P11029	25	2.04 :1
PX9724A	* P9724	26	1.92 :1	PX9725A	* P9725	26	1.92 :1
PX9722A	* P9722	28	1.75 :1	PX9721A	* P9721	28	1.75 :1
PX9746	* P9746	31	1.48 :1	PX9719	* P9719	31	1.48 :1
PX9718A	* P9718	35	1.20 :1	PX9747A	* P9747	35	1.20 :1
PX9748	* P9748	37	1.03 :1	PX9749	* P9749	37	1.03 :1

● NOT SERVICEABLE SEPERATELY . FOR SERVICE USE PX10022A PINION HUB ASSEMBLY, CONSISTING OF PX9727A PINION ASSEMBLY AND P9876 HUB.

INPUT SPEED SENSOR:

APPLY ANAEROBIC SEALANT MEETING"MA908 (LOCTITE 242)" TO SPEED SENSOR THREADS. ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, AND THE BACK OUT SENSOR "ONE" FULL TURN. USE JAM NUT TO SECURE SENSOR POSITION.

SECTION : "C–C" (K)

1020553	1	
M2027–AP	1	◑
M2081–J	1	

SEE NOTE #4 (Q)

WITH THRU DRILLED HOLE

SEE NOTE #2

SEE NOTE #6

S.A.E. #2

SEE NOTE #8

SAE#2

"C"

SEE NOTE #6

SEE NOTES #1 & #4

SEE NOTE #2

SEE NOTE #4

SEE NOTE #3

SEE NOTES #1 & #5B

SEE NOTE #8

SEE NOTE #7

SEE NOTE #6

S.A.E. #1

SEE NOTE #8

SAE#1

SEE NOTE "a"

M422	8	
B2411C	1	
P–11954	1	

MOUNT INSTRUCTION PLATE WITH WORDS "HIGH PERFORMANCE MARINE TRANSMISSION LUBRICANT" READABLE FROM BREATHER SIDE OF UNIT.

HIGH PERFORMANCE MARINE TRANSMISSION LUBRICANT

M2080A	1	
A2916BV "O" RING	1	

PX–11939C HOUSING ASS'Y SAE #1.	1	▼
PX9681C	1	*
PX9697	1	*
A2711S DOWEL PIN	2	
PM9338H HELI–COIL	4	
PM1357W SCREW HEX HD	1	
PM1357E SCREW HEX HD	3	
PM2057AJ WASHER FLAT	4	

PX11939B HOUSING ASS'Y SAE #2.	1	
PX9681C	1	*
PX9696	1	*
A2711S DOWEL PIN	2	
PM9338H HELI–COIL	4	
PM1357W SCREW HEX HD	1	
PM1357E SCREW HEX HD	3	
PM2057AJ WASHER FLAT	4	

PX11939A HOUSING ASS'Y SAE #1.	1	▼
PX9681C	1	*
PX9697	1	*
A2711S DOWEL PIN	2	
PM9338H HELI–COIL	4	
PM1357W SCREW HEX HD	1	
PM1357E SCREW HEX HD	3	
PM2057AJ WASHER FLAT	4	
M1945AM CUP PLUG	1	◆

PX11939 HOUSING ASS'Y SAE #2.	1	
PX9681C	1	*
PX9696	1	*
A2711S DOWEL PIN	2	
PM9338H HELI–COIL	4	
PM1357W SCREW HEX HD	1	
PM1357E SCREW HEX HD	3	
PM2057AJ WASHER FLAT	4	
M1945AM CUP PLUG	1	

PX–11729A	1	● * *
P–11729	1	
P–11727A	1	
M2051EJ ORIFICE PLUG	1	
M1990C STEEL BALL	1	
M1945BC PLUG	1	

PX–11729	1	* *
P–11729	1	
P–11727	1	
M2051EJ ORIFICE PLUG	1	

PM–4963AM	2	
M1904GZ	2	N
P–11728	2	
A2916HX	2	
P–12122	22	
P–12255	20	
PM8147B	2	
B3477B	2	
PM1298AX	2	
P9736P	2	O
M2086P	2	
M2693A	1	
SEE CHART	4	
M2086BJ	4	
M2087D	4	
M2086BH	2	
MA487	1	
M1904P	4	
B2322B	1	
PM1996U	4	
PX9330	1	

SEE NOTE "a"

P–11826	1	
MA991	1	
XB2508	1	
B2508	1	*
M1927BV ROLL PIN	1	
B2505A	AS REQ'D.	
B2505B		
B2505C		
B2505D		
P–9473 VKE–4015 / P–9472 VKE–4011	1	
P9743	1	
PM2057AJ	12	
PM1357W	12	
PM9741	1	
PX9737	1	
P9737	1	*
M1927BV ROLL PIN	1	
PM–1677N	2	
P9736	AS REQ'D.	
P9736A		
P9736B		
P9736C		
MA659A	1	
PX–9740	1	
P–9740	1	
M1841P	1	
P–11732	1	
PM–4330T	1	
P–11826	1	
PX–11801	2	
P–11802 VALVE CARTRIDGE	1	*
1020099 PISTON	1	*
P–11849 SPRING	1	*
PM–3036AE ROLL PIN	1	*
A2916KH "O" RING	1	
B1048U SNAP RING	1	

PX–11725	1	
P–11725	1	*
P–11726	1	*
M2051EJ ORIFICE PLUG	1	
M1990E STEEL BALL	1	

PX–11725A	1	●
P–11725A	1	*
P–11726A	1	*
M2051EJ ORIFICE PLUG	1	
M1990E STEEL BALL	1	
M1945BC PLUG	1	
M1990C STEEL BALL	1	

M2355	1	
P9738	AS REQ'D.	
P9738A		
P9738B		
P9738C		

PX9739	1	
P9739	1	*
M1927BV ROLL PIN	1	
PM1357D	2	
PM2057AJ	2	
P–9843	1	
P9729A 2.50 :1	45 T	
P11031 2.04 :1	1 / 51 T	
P9726A 1.92 :1	1 / 50 T	
P9723A 1.75 :1	1 / 49 T	
P9766 1.48 :1	1 / 46 T	
B6352A 1.20 :1	1 / 42 T	
B5972A 1.03 :1	1 / 38 T	

M–2006–C	1	(E)
PM–1349AA	1	(J)
P9734A	1	
PM2009R	1	
P9733	1	
PM2306A	1	
P9926	1	
B2130B	1	
PM1996T	1	
M2048AH	1	
A2916JT	1	
PM10667B	1	
SEE CHART	1	
M1927CV	2	
P9735	2	
M1945AG	1	◆
PM4963AX	2	
MA487	1	
P9711A	1	
P9742	1	
MA922A	1	
M2272A	1	
P9925	1	
M2074S	1	
B1504AY	1	
MA996F	3	
B2423	AS REQ'D.	
B2423A		
B2423B		
B5872A	1	
P–9477 VKE–4015 / P–9476 VKE–4011	1	▼
P–11737	1	
PM–2306–C	2	

MA656D	1	
B3631S	1	
PM–3533–BT	1	(F)
PM–3353–A	1	
PX9840	1	
100535.35	1	*
100535.34	1	*
MA842G FERRULE	1	*
MA841G	1	*
MA568S	1	*
PM–1996–T	1	(B)
PM–1996–U	3	
PM–1627–A	2	
PX–11653	1	
P–11706	1	
PM–1357–D	4	
M–2067–D	2	(F)

FOR E–TROLL MODULE		
1020584	1	
1020282	11	
MA1039–J	6	
MA1097–B	4	

FOR PROFILE MODULE		
1020586	1	
1020282	5	
MA1039–J	6	
MA1097–B	4	

FOR L.H. ENGINE ROTATION ONLY		
201513	1	
M422	2	

1021658H	1	(L)(B)(R)(J)(F)
MA–1052–U	4	
MA–1053–G	1	
B1337–J	1	

MA1038F	3	
M–2055–AR	1	(F)
PM1996R	2	
PM2057Z	4	
PM1996P	2	
PM2145D	1	
PM1349Q	1	
A2916BV	1	
MA1038A	1	
PM–1190–C	2	
A–2888–AW	1	
P–11791–A	1	
MA1040C	1	

DIRECTION OF ROTATION

TWIN DISC ®

"D"

OUTPUT SPEED SENSOR:

APPLY ANAEROBIC SEALANT MEETING"MA908 (LOCTITE 242)" TO SPEED SENSOR THREADS. ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, AND THE BACK OUT SENSOR "TWO" FULL TURN. USE JAM NUT TO SECURE SENSOR POSITION.

SECTION : "D–D" (K)

1020552	1	
PM2057–X	2	◑
M2027–AP	1	

SECTION A–A

ASSEMBLY INSTRUCTIONS

ASSEMBLE AND TEST PER S570BL NOTES 1 THRU 8 ARE IN S570BL (J)

THESE STANDARDS APPLY:

S574– FASTENER TORQUE REQUIREMENTS.
S692– THRUST BEARING SHIMMING.
S765– TAPERED JOINT ASSEMBLY.

CUSTOMER NOTES:

a) OIL CAPACITY 7.60 L , LESS HOSES AND HEAT EXCHANGER.
b) ROTATION ARROW AND PUMP POSITION FOR R.H. ENGINE IS SHOWN. FOR L.H. ENGINES, ROTATION PLATE (ARROW POINTING TO RIGHT) AND SCREWS MUST BE ADDED TO INDICATE OPPOSITE DIRECTION AND PUMP TO BE RELOCATED PER INSTRUCTIONS SHOWN ON SHEET 2.
c) OPTIONAL EQUIPMENT:
COMPANION FLANGE ASS'Y. :XB5917
LIVE P.T.O. PX–9768
HYDRAULIC CLUTCHED P.T.O.SHAFT DRIVE:PX–12014
HYDRAULIC CLUTCHED P.T.O.PUMP DRIVE:PX–12014–A
HEAT EXCHANGER ON UNIT: SEE SHEET 3
OIL TEMPERATURE INDICATING SWITCH :B3424, FOR INSTALLATION LOCATION, SEE HYDRAULIC DIAGRAM AND SHEET 3.
OIL PRESSURE GAGE :B1703D FOR INSTALLATION LOCATION, SEE HYDRAULIC DIAGRAM AND SHEET 3.
∗ NOT SERVICEABLE SEPARATELY

◆ NOT SUPPLIED IN UNITS EQUIPPED WITH HYDRAULIC P.T.O.
● USE ABOVE 2500 RPM
▼ OPTIONAL FOR S.A.E. #1 (K) ◑ OPTIONAL FOR SPEED SENSORS.

F	6653	19AUG02	M	7090	13FEB04						
E	6629	13MAY02	L	7054	19DEC03						
D	6621	25APR02	K	6986	29OCT03	R	7346	4JAN05			
C	6611	05APR02	J	6910	1JULY03	Q	7258	16SEP04			
B	6604	26MAR02	H	6900	23JUN03	P	7190	09JUN04			
A	6583	28FEB02	G	6875	21MAY03	N	7156	26APR04			
REV	CH. NO.	DATE	REV	CH. NO.	DATE	REV	CH. NO.	DATE	REV	CH. NO.	DATE

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MATERIAL	
HEAT TREAT	
SURFACE TREATMENT	
WEIGHT	205Kg
WR²	LBS. IN²
FIRST USE	
ASSY.	
MODEL	
NAME	MGX–5114A MARINE TRANSMISSION

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS X.X ±0.030, X.XX ±0.010, X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE	7DEC2001
SCALE	1/2
DRN.	JCP
CHK.	VR
APPD.	JCP

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

PX–11730

SHEET 1 REV R

SHEET 1 OF 8	CROSS SECTION WITH PART NUMBERS
SHEET 2 OF 8	INSTALLATION DRAWING
SHEET 3 OF 8	INSTALLATION DRAWING
SHEET 4 OF 8	MOUNTING PADS
SHEET 5 OF 8	4–VIEWS DRAWING
(H) SHEET 6 OF 8	FLEXIBLE COUPLING
(L) SHEET 7 OF 8	SPECIAL INSTALLATION FOR MTU–DDC
(M) P–12182	HYDRAULIC DIAGRAM
P5244M	MASS ELASTIC SYSTEM
SHEET 8 OF 8	FLEXIBLE COUPLING (VULKAN)

THIRD ANGLE PROJECTION

CONSULT SALES DEPT. APPLICATION ENGINEERS FOR LIMITING CONDITIONS.

GEAR RATIOS: 1.03 :1, 1.20 :1, 1.48 :1, 1.75 :1, 1.92 :1, 2.04 :1, 2.50 :1

SIMILAR TO 1020116

F E D C B A

OPTIONAL TEMPERATURE INDICATING SWITCH :
CUSTOMER TO INSTALL IN A 3/4x3/4 x3/4PIPE TEE IN THE HYDRAULIC LINE LEADING FROM THE MARINE TRANSMISSION PUMP TO THE M.T.E. INLET. REFER TO HYDRAULIC DIAGRAM.

OPTIONAL OIL PRESSURE GAGE :
CUSTOMER TO INSTALL GAGE IN PILOT HOUSE AND CONNECT LINE FROM GAGE HERE. 1/8–27 NPTF.EXTERNAL TH'D.(DRYSEAL)AT GAGE.

ELECTRIC CONTROL VALVE (1021658H)

CARTRIDGE VALVE CONNECTIONS ARE NOT POLARITY SENSITIVE. CONNECTOR MATES WITH METRIPACK 150 SERIES.

107.9 (4.25)–ENGAGING SECONDARY CLUTCH
103.24 (4.06) AT NEURAL POSITION
98.3 (3.87)–ENGAGING PRIMARY CLUTCH
188.13 [7.41]
34.92 [1.37]
MAIN PRESSURE CHECK M12x1.5 TH'D(ISO–6149)
MECHANICAL BACK UP VALVE
MECHANICAL PULL/PUSH EFFORT REQUIRED: 111–156N (25–35Lb) FROM NEUTRAL POSITION 36–53N (8–12Lb) FROM SHIFTED POSITION
63.67 [2.51]
65.79 [2.59]
ON THIS SIDE
SECONDARY CLUTCH ACTUATING PRESSURE –M12x1.5(ISO–6149) (ZSC)
62.65 [2.47]
82.65 [3.25]
ON OPPOSITE SIDE
PRIMARY CLUTCH ACTUATING PRESSURE –M12x1.5(ISO–6149) (ZPC)

HEAT EXCHANGER (H.E.) REQUIREMENTS

REFER TO B3649 FOR HEAT EXCHANGER REQUIREMENTS

"D" DRILL THRU 12 HOLES EQUALLY SPACED USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898–1 USE HARDENED FLAT STEEL WASHERS, R 3ON 61 MIN. UNDER SCREW HEADS GRADE AND TORQUE TO S574 OR SERVICE MANUAL VALUES.

"M" DRILL THRU 8 HOLES EQUALLY SPACED USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898–1 AND TORQUE TO S574 OR SERVICE MANUAL VALUES.

420.5 [16.56]
418.2 [16.46]
378.5 [14.90] BREATHER AND OIL FILLER ℄
351.4 [13.83]
247.3 [9.74] FOR 157.2[6.19] ℄ BOLT EYE "X"
219.2 [8.63]
194.3 [7.65] FOR 263.6[10.38] ℄ BOLT EYE
176.0 [6.93]

FLYWHEEL OUTLINE MUST CONFORM TO S.A.E. J620 290

"K" "G" "H" "J" "L"

SAE#1 HOUSING
OIL FILLER ℄ 9/16–18 UN–2B TH'D.
OIL GAUGE ℄
MECHANICAL BACK UP VALVE
CENTER OF GRAVITY
PRIMARY CLUTCH SHAFT ℄
CLEARANCE TO REMOVE PUMP
SECONDARY CLUTCH SHAFT ℄
OUTPUT SHAFT ℄
OPTIONAL EXTRA SUPPLIED ONLY WHEN SO SPECIFIED
OPTIONAL TEMPERATURE PICK–UP HOLE M14X1.5 TH'D.
15.0 [.59] CLEARANCE TO REMOVE DRAIN PLUG
FLYWHEEL OUTLINE MUST CONFORM TO S.A.E. J620 NO. 355
M16x2 TH'D. 22.0 [.86] DEEP 12 HOLES (6 EACH SIDE) USE ALL (12) HOLES FOR MOUNTING USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898–1 AND TORQUED TO S574 OR SERVICE MANUAL VALUES.

"A" DIA. "B" DIA.H.C. "C" DIA. "E" DIA. "F" DIA. H.C. "Y"
314.4 [12.38] DIA.
409.4 [16.12] DIA.
121.2 [4.77]
130.0 [5.12]
15.5 [.61]
101.1 [3.979] BASIC
(2PLACES) 25.4 [1.00] (2PLACES) 203.2 [8.00]
152.4 [6.00] BASIC
91.4 [3.60] CLEARANCE TO REMOVE SUCTION SCREEN
40.6 [1.60] (ALL PADS)
26.7 [1.05] (2PADS)
101.6 [4.00]
39.7 DIA [5.50] BORE WITH 3.05[3/4] SQUARE K'WY. CUSTOMER TO FIN. BORE
38.1[1.50] MIN. 76.2[3.00] MAX.
17.8 [.70]
1.02–1.52 [.04–.06]
3.94–4.32 [.15–.16]
228.6 DIA. [9.00]
152.40 DIA. [6.000] [5.998]
152.40 [6.00]
190.5 DIA. H.C. [7.50]
26.7 [1.05]
50.8 [2.00]
101.6 [4.00] (2 PADS)
31.0 [1.22]
51.8 [2.04]
114.0 [4.49] (2 PADS)
338.6 [13.33]
478.5 [18.84]
573.4 [22.58]

PRIMARY SOLENOID ENGAGED CLUTCH ON PRIMARY SHAFT
263.7[10.38]
235.1[9.26]
164.0 [6.42]
157.2 [6.19]
136.1 [5.40]
8.6 APPROX. [.34]
DIRECTION OF ROTATION
SECONDARY SOLENOID ENGAGED CLUTCH ON SECONDARY SHAFT
25.4 [1.00]
120.2 [4.75]
101.3 [3.99]
DISTANCE REQUIRED TO REMOVE OIL GAGE. GAGE IS FLEXIBLE AND CAN BE BENT IF NECESSARY.
INPUT SPEED PICK–UP (G)
138.9 [5.47]
74.7 [2.94]
BREATHER AND OIL FILLER HOLE.
℄ OIL GAUGE HOLE
130.0 [5.12]
PRIMARY CLUTCH ACTUATING PRESSURE M14X1.5 TH'D(ISO–6149) (ZPC)
SECONDARY CLUTCH ACTUATING PRESSURE M14X1.5 TH'D(ISO–6149) (ZSC)
2 TAPPED HOLES–M16x2 UNC THREAD 33.0(1.30) DEEP WITH 16.7(21/32) DIA C'BORE 7.9(.31) DEEP.FOR STANDARD EYE BOLTS.THESE HOLES MAY BE USED FOR LIFTING MARINE TRANSMISSION ONLY.
22.6 [.89]
53.5 [2.11]
88.1 [3.47]
137.2 [5.40]
"Z"
LUBE P.S.I. M14X1.5 TH'D (ISO–6149) (G)
73.7 [2.90] FOR L.H. ENGINE
94.7 [3.73] FOR R.H. ENGINE
15.5 [.61]
OIL OUT TO HEAT EXCHANGER 3/4–14 NPTF TH'D.REMOVE PLASTIC PROTECTOR BEFORE OPERATING UNIT.
OIL IN FROM HEAT EXCHANGER 3/4–14 NPTF TH'D.REMOVE PLASTIC PROTECTOR BEFORE OPERATING UNIT.
R.H. ENGINE PUMP AND PLUG POSITION SHOWN SOLID. FOR L.H. ENGINE, ROTATE PUMP 180° AS SHOWN PHANTOMED AND RELOCATE STEEL SOCKET PLUG AS SHOWN.
102.9 [4.05]
CENTER OF GRAVITY
TWIN DISC ®
FORWARD WITH R.H. ENGINE DRIVING THRU PRIMARY CLUTCH
OUTPUT SPEED PICK–UP (G)
218.9 [8.62]
SECONDARY CLUTCH SHAFT ℄
OIL DRAIN PLUG M27x2 TH'D(ISO–6149)
M10x1.5– 7.6[.30] DEEP SUCTION SCREEN
22.6[57/64] DRILL THRU 8 HOLES EQUALLY SPACED. USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898–1 AND TORQUE TO S574 OR SERVICE MANUAL VALUES.
135.1 [5.32] FOR R.H. ENGINE
159.0 [6.26] FOR L.H. ENGINE
161.5 [6.36]
172.7 [6.80]
203.2 [8.00]
279.4 [11.00]
"A" DIA. "B" DIA.H.C. "C" DIA. "E" DIA. "F" DIA. H.C. "Y"
103.8 [4.09]
118.3 [4.66]
201.7 APPROX. [7.94]
603.0 APPROX. [23.74]
290.6 [11.44]
336.5 [13.25]

INCH DIMENSIONS AND POUNDS SHOWN IN BRACKETS

NOTE : ALL POINTS AVAILABLE FOR TESTING ARE CODED ⬡

SAE NO.	S.A.E. J620 MARINE TRANSMISSION FLYWHEEL NO.	A	B	C ± 0.000 0.127 [± .000 .005]	D	E ± 0.000 0.127 [± .000 .004]	F	G	H	J	K	L	M
1	355	552.4 [21.75]	530.2 [20.875]	511.175 [20.125]	11.9 [15/32]	466.725 [18.375]	438.15 [17.250]	22.4 [.88]	25.4 [1.00]	4.0 [.16]	6.1 [.24]	11.2 [.44]	14.0 [.551]
1	290	552.4 [21.75]	530.2 [20.875]	511.175 [20.125]	11.9 [15/32]	352.425 [13.875]	333.4 [13.125]	22.4 [.88]	39.6 [1.56]	4.0 [.16]	6.1 [.24]	11.2 [.44]	11.0 [.433]
2	290	489.0 [19.25]	466.7 [18.375]	447.675 [17.625]	10.7 [27/64]	352.425 [13.875]	333.4 [13.125]	22.4 [.88]	39.6 [1.56]	4.0 [.16]	6.1 [.24]	11.2 [.44]	11.0 [.433]

SAE NO.	CENTER OF GRAVITY X	Y	Z
1	227.2 [8.944]	89.03 [3.505]	46.28 [1.822]
2			

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MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT 205Kg
WR² LBS. IN²
FIRST USE
ASSY.
MODEL
NAME MGX–5114A MARINE TRANSMISSION

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS X.X ±0.030 X.XX ±0.010 X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

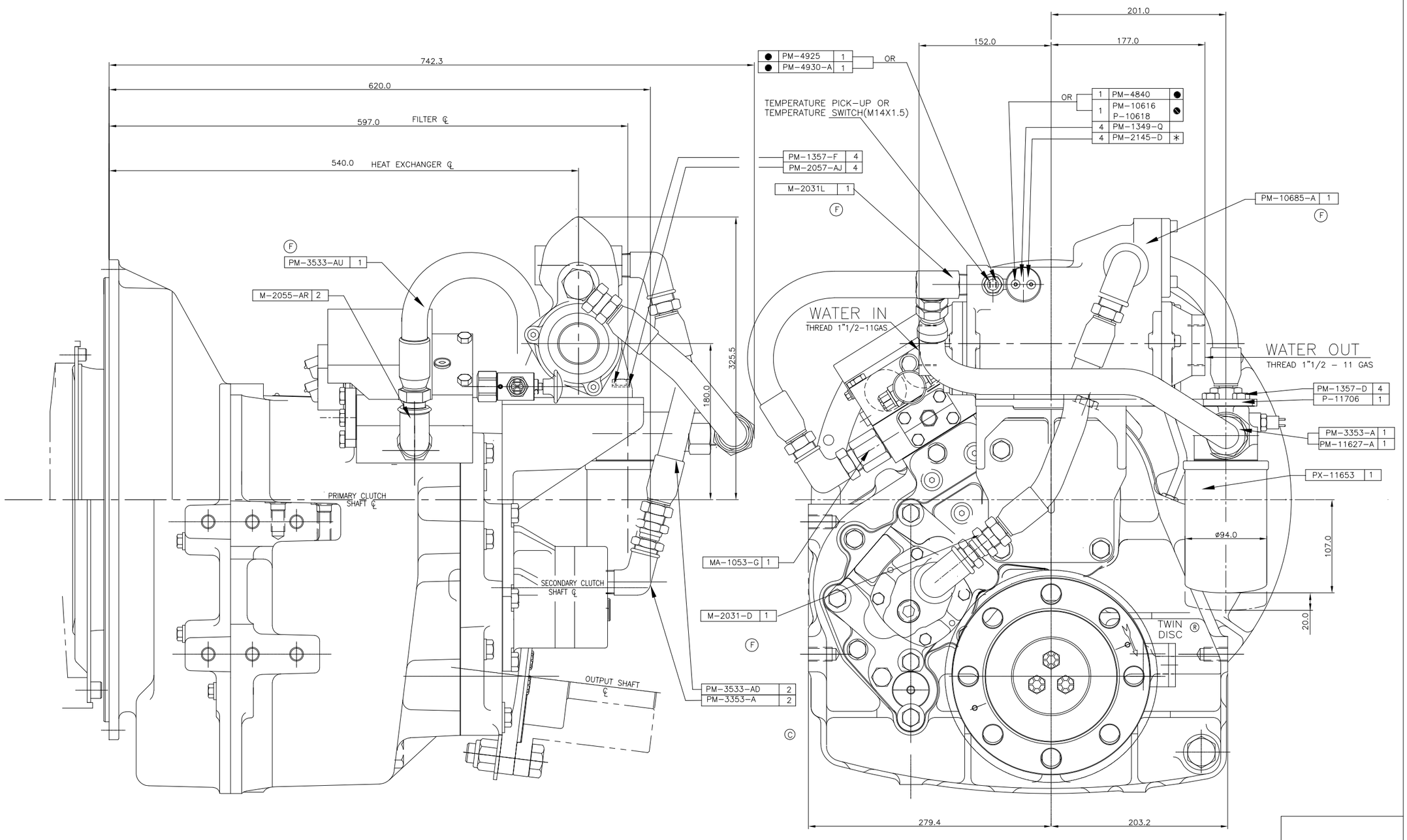
THIRD ANGLE PROJECTION

SIMILAR TO 1020116

DATE 26MAR02
SCALE 1/2
DRN. J.D.
CHK. VR
APPD. PJC
SHEET 2
REV R

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

PX–11730



FOR OTHERS INSTALLATION DIMENSIONS
SEE DRAWING PX 11730 SHEET 2.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO : PX-9700-B	MATERIAL	WEIGHT kg	WR² Nm²	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X ±0.75, X.X ±0.25, X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982	DATE 23MAY02
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	SURFACE TREATEMENT	NAME MGX-5114-A-MARINE TRANSMISSION			DRAWN RZ
					CHECKED VR
					APPROVED PJC

TWIN DISC INCORPORATED
RACINE, WI 53403 – USA

PX-11730

SHEET: 3 | REVISION : R | FORMAT A1

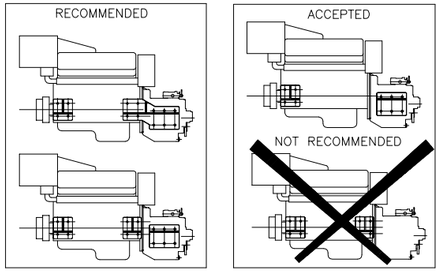
HEAT EXCHANGER (H.E.) REQUIREMENTS

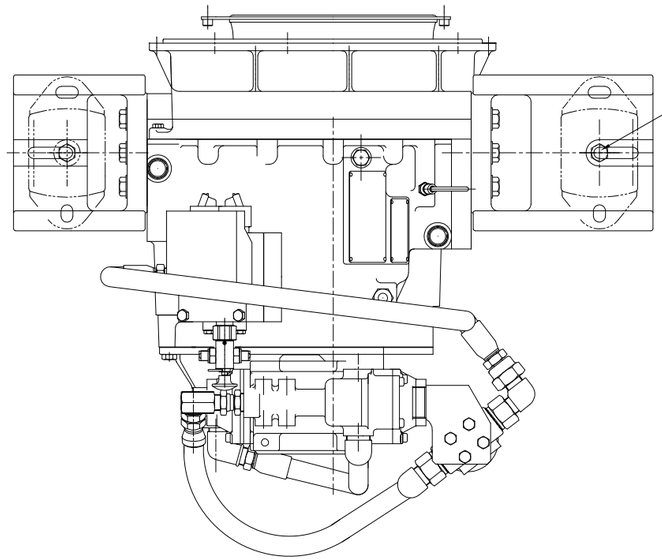
REFER TO B3649 FOR HEAT EXCHANGER REQUIREMENTS

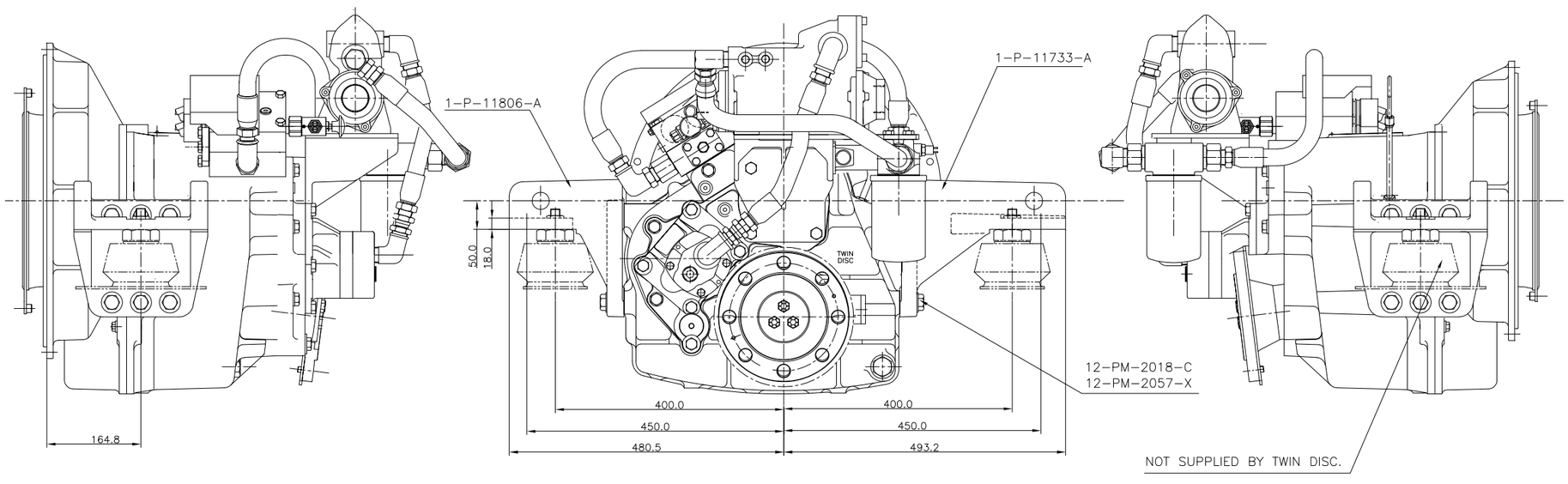
NOTE:

WHEN MOUNTING ENGINE/TRANSMISSION IN BOAT, ALL THE MOUNTING PADS ON THE ENGINE MUST BE USED – PLUS THE TRANSMISSION SIDE MOUNTING PADS. FAILURE TO DO SO MAY RESULT IN DAMAGE TO TRANSMISSION. SEE BELOW:

THE PX–11730 CONFIGURATION IS NOT SUITABLE FOR REMOTE MOUNTING.







FOR OTHERS INSTALLATION DIMENSIONS SEE DRAWING PX 11730 SHEET 2.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO :PX–9700–B	MATERIAL	WEIGHT kg	WR² Nm²	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X. ±0.75 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982	DATE 25MAY02	TWIN DISC INCORPORATED RACINE, WI 53403 – USA
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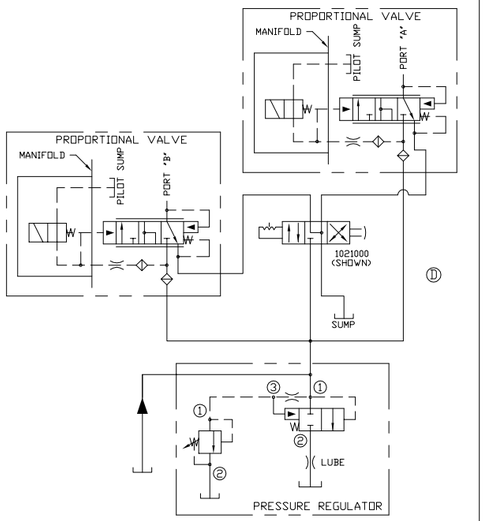
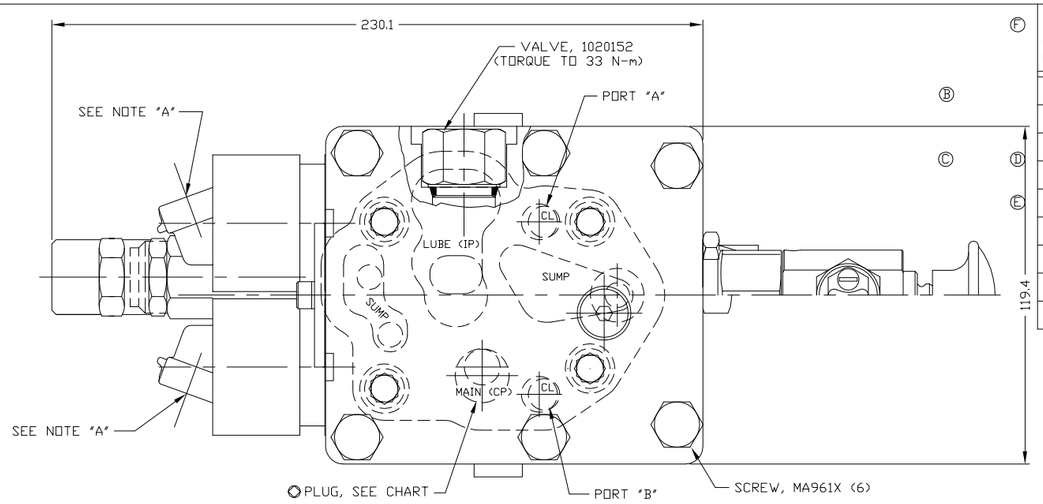
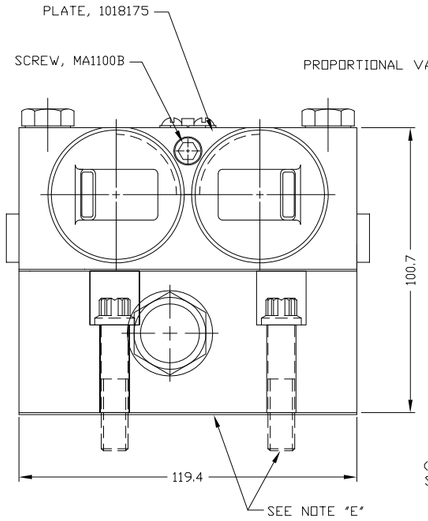
	SURFACE TREATEMENT	NAME MARINE TRANSMISSION MGX–5114 A			DRAWN RZ CHECKED V.R. APPROVED P.JC	PX–11730
					SHEET 4	REVISION : R	FORMAT A1

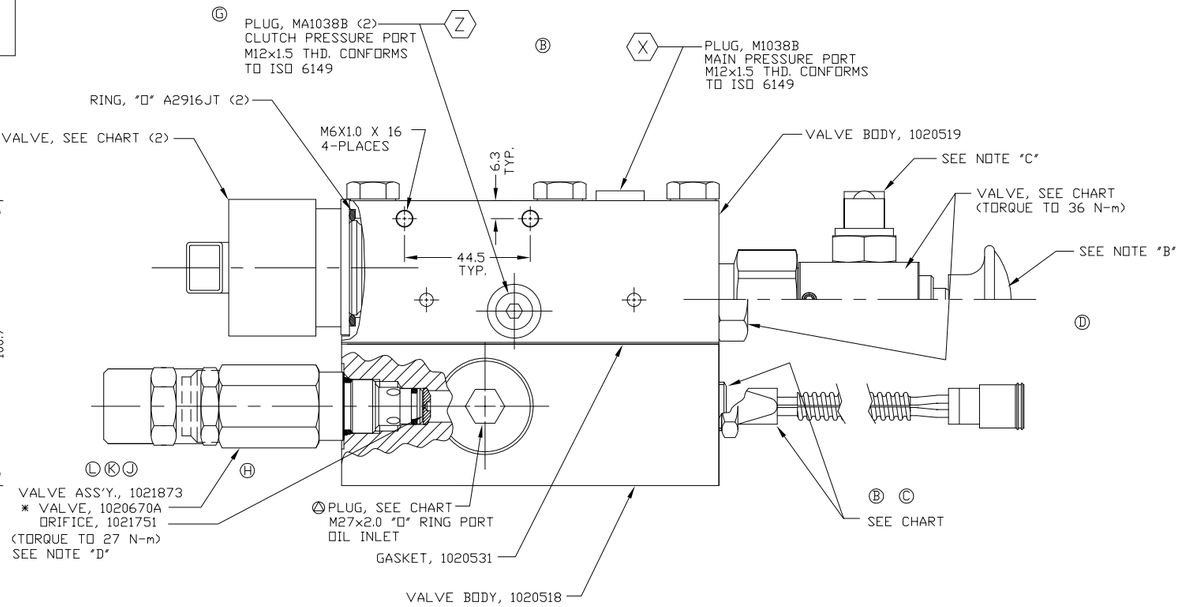


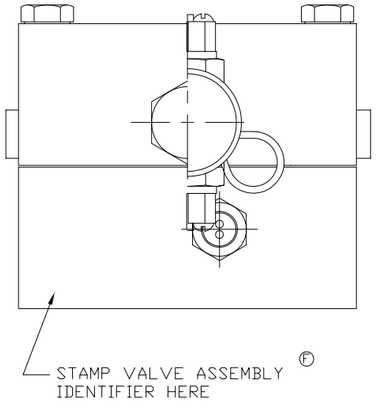
HYDRAULIC DIAGRAM (GRAPHIC SYMBOLS)



VALVE ASSEMBLY PART NO.	BOM	VALVE ASSEMBLY IDENTIFIER	VALVE Ⓛ	SENSOR	◇ PLUG	△ PLUG	CORE PLUG SEE NOTE "F"	PROPORTIONAL VALVE (PSI)
1020729A	42223	A	1021000A	1016122A	NONE	MA1038E	NONE	1020520 (350)
1020729B	42426	B	1021000A	1016122A	NONE	MA1038E	NONE	1018528 (250)
1020729C	42127	C	1021000A	NONE	M2051S	MA1038E	NONE	1018528 (250)
1020729D	42126	D	1021000A	NONE	M2051S	MA1038E	NONE	1020520 (350)
1020729E	42516	E	1020542	NONE	M2051S	MA1038E	M1945E PORT "A"	1018528 (250)
1020729F	42974	F	1021000A	NONE	M2051S	MA11185A	NONE	1018528 (250)




PLUG, MA1038B (2) CLUTCH PRESSURE PORT M12x1.5 THD. CONFORMS TO ISO 6149
RING, "O" A2916JT (2)
PROPORTIONAL VALVE, SEE CHART (2)
M6X1.0 X 16 4-PLACES
6.3 TYP.
PLUG, M1038B MAIN PRESSURE PORT M12x1.5 THD. CONFORMS TO ISO 6149
VALVE BODY, 1020519
SEE NOTE "C"
VALVE, SEE CHART (TORQUE TO 36 N-m)
SEE NOTE "B"
44.5 TYP.
VALVE ASS'Y., 1021873
* VALVE, 1020670A
ORIFICE, 1021751
(TORQUE TO 27 N-m)
SEE NOTE "D"
PLUG, SEE CHART M27x2.0 "O" RING PORT OIL INLET
GASKET, 1020531
VALVE BODY, 1020518
SEE CHART



NOTES :

A. PROPORTIONAL CONTROL VALVE OPERATION
   1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTTERY/POWER SUPPLY VOLATAGE.
   2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION
   1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PORT "A"
   2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE PORT "B"

C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH
   1. SWITCHES ARE NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION
   2. CURRENT = 20 AMPS MAX.
   3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

D. PRESSURE REGULATOR INITIAL ADJUSTMENT PROCEDURE
   1. WITH NO OIL FLOW TO VALVE, TURN ADJUSTMENT STEM OF THE 1020670A VALVE COUNTER-CLOCKWISE UNTIL REACHING POSITIVE STOP.
   2. WITH A MINIMUM OF 1 gpm, ALLOW OIL TO FLUSH PRESSURE RGEULATOR.
   3. AFTER FLUSHING, TURN ADJUSTMENT STEM OF THE 1020670A VALVE CLOCKWISE UNTIL REACHING REQURIED PRESSURE SPCIFIED IN MARINE TRANSMISSION PRODUCTION TEST SPECIFICATION.
   4. LOCK ADJUSTMENT STEM IN PLACE USING JAM NUT AND CAP.

E. REFER TO MARINE TRANSMISSION ASSEMBLY DRAWING OR BILL OF MATERIAL FOR VALVE MOUNTING GASKET AND SCREWS.

F. APPLY ANAEROBIC SEALANT MEETING M2828 REQUIREMENTS AROUND CORE PLUG, JUST BEFORE FINAL ASSEMBLY. REFER TO S774 FOR FURTHER INFORMATION.

* NOT SERVICEABLE SEPARATELY

Ⓑ REVISED AND REDRAWN - SUPERSEDES 1020729 DATED 8-9-02

Ⓜ OBSOLETE: REPLACED BY 1021658 FOR PRODUCTION AND SERVICE

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
M		A2	ECN12561	7-28-04	F		B6	ECN11978	11-18-03
L		B6 E2	ECN12457	5-28-04	E		B6	ECN11761	8-14-03
K		E2	ECN12413	5-7-04	D			ECN11703	7-30-03
J		E2	ECN12314	3-24-04	C			ECN11529	5-2-03
H		E3	ECN12058	12-18-03	B			ECN11368	4-08-03
G		E4	ECN12015	12-03-03	A			ECN11321	1-30-03

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MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT lbs / WR² N·m²

FIRST USE
ASSY.
MODEL MGX-5114A
NAME VALVE ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

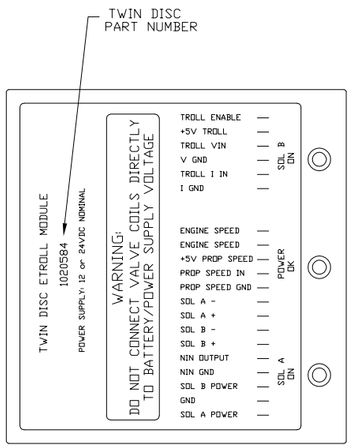
DATE 8-9-02
SCALE 1 : 1
DRN. D. MEYERS
CHK. ALC
APPD. GAM

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1020525

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

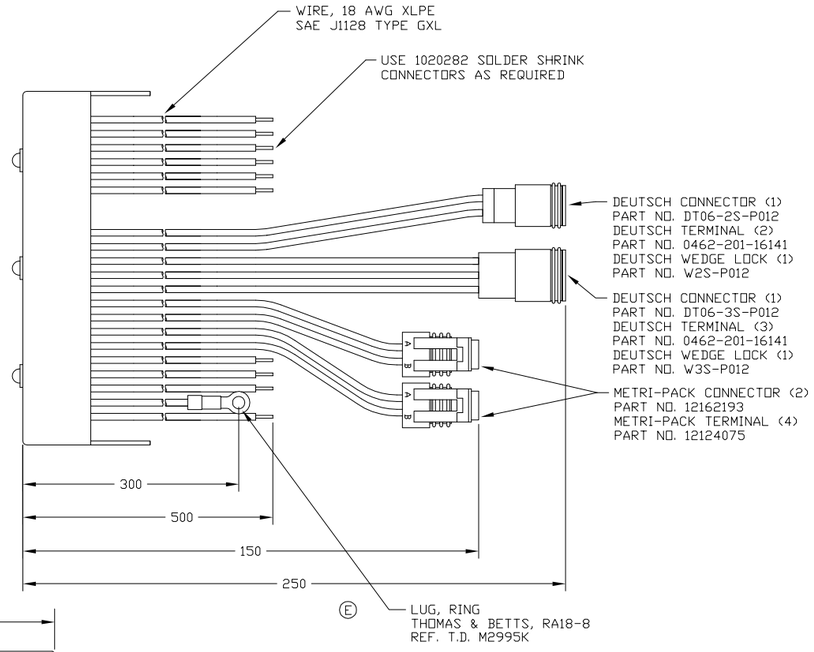
1020729 SERIES

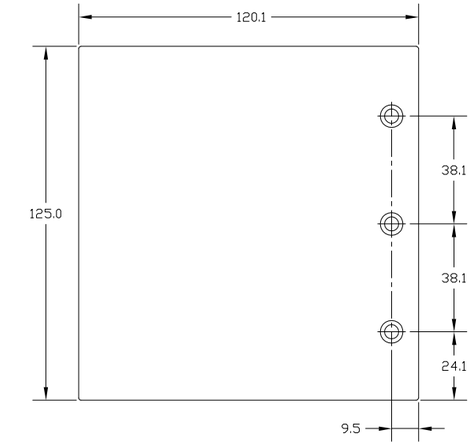
SHEET 1 OF 1 REV M



TWIN DISC PART NUMBER

Ⓐ

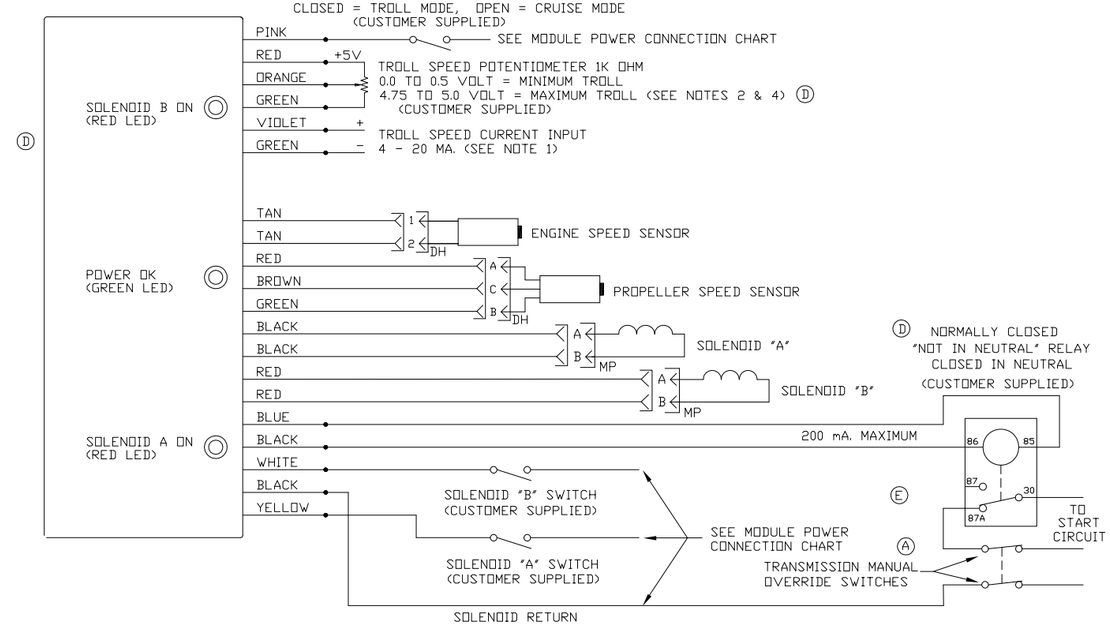




Ⓑ

• = WIRE SPLICE PART # 1020282
DH = DEUTSCH CONNECTOR
MP = METRIPACK CONNECTOR

WIRING SCHEMATIC



MODULE POWER CONNECTION CHART

USE OPTION 1 CONNECTIONS WHEN THE MODULE IS CONNECTED TO NON-ELECTRONIC LEVER HEADS.

USE OPTION 2 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC GEAR CONTROLLERS.

USE OPTION 3 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC CONTROL SOLENOID DRIVER OUTPUTS. THE ELECTRONIC CONTROL'S SOLENOID "A" AND "B" RETURNS OR NEGATIVE SIGNALS SHOULD BE CONNECTED TOGETHER AND CONNECTED TO THE "ETROLL" MODULE RETURN. ELECTRONIC CONTROL SOLENOID DRIVERS MUST HAVE THEIR SOLENOID RETURN INTERNALLY CONNECTED DIRECTLY TO GROUND. IF NOT, THE MODULE MUST BE INTERFACED TO THE ELECTRONIC CONTROL WITH RELAYS.

WIRE	WIRING OPTION 1	WIRING OPTION 2	WIRING OPTION 3
TROLL ENABLE SWITCH RETURN	CONNECT TO THE NEGATIVE TERMINAL OF THE ENGINE BATTERY	CONNECT TO THE SAME GROUND POINT USED BY THE GEAR CONTROLLER OR THE ENGINE CONTROL.	CONNECT TO THE SAME POINT AS THE CONTROL'S POWER GROUND SIGNAL
SOLENOID B SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE CONTROL'S SOLENOID B POSITIVE DRIVER OUTPUT.
SOLENOID RETURN	CONNECT TO THE NEGATIVE TERMINAL OF THE ENGINE BATTERY	CONNECT TO THE SAME GROUND POINT USED BY THE GEAR CONTROLLER OR THE ENGINE CONTROL.	CONNECT TO THE CONTROL'S SOLENOID NEGATIVE OUTPUT CIRCUIT.
SOLENOID A SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID A.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS TO ENERGIZE SOLENOID A.	CONNECT TO THE CONTROL'S SOLENOID A POSITIVE DRIVER OUTPUT.

NOTE: FOR USE ON MOMINAL 12/24 VDC SYSTEMS.

LED INDICATORS
- GREEN LED ILLUMINATED WHEN POWER IS GREATER THAN 9.0 VOLTS
- RED LED ILLUMINATED INDICATES VALVE COIL COMMANDED ON.
- ONE RED FLASHING INDICATES AN OPEN CIRCUIT IN AN ENERGIZED VALVE COIL CIRCUIT, VALVE COIL LEADS SHORTED TOGETHER, OR LOW COIL CURRENT.
- RED LEDS FLASH SIMUTAINIOUSLY AFTER ENTERING TROLL FROM NEUTRAL WITH BOTH VOLTAGE AND CURRENT TROLL SPEED SIGNALS PRESENT OR WHEN POWER IS APPLIED TO SOLENOID "A" AND "B" SWITCH INPUTS AT THE SAME TIME.
- RED ALTERNATELY FLASHING INDICATES EITHER OR BOTH SPEED SIGNALS MISSING

NOTE 1: WHEN TROLL SPEED CURRENT INPUT IS USED TO CONTROL TROLL SPEED, THE ORANGE AND GREEN TROLL SPEED POTENTIOMETER INPUT WIRES MUST BE ELECTRICALLY CONNECTED TOGETHER WITH A SOLDER SHRINK CONNECTOR AND SECURED. THE RED WIRE MUST BE INSULATED AND ALL 3 WIRES SECURED.

NOTE 2: WHEN TROLL SPEED VOLTAGE INPUT IS USED TO CONTROL TROLL SPEED, THE VIOLET AND GREEN WIRES MUST BE INSULATED AND SECURED.

Ⓐ Ⓓ NOTE 3: PROPELLER SPEED SENSOR MUST BE TWIN DISC SUPPLIED PART.

NOTE 4: TO INITIATE TROLL WITHOUT THE 0.5 VOLT DEAD BAND AT MINIMUM TROLL, ADD A 100 OHM RESISTOR BETWEEN THE POTENTIOMETER AND THE GREEN WIRE.

NOTE 5: WHEN THE "NOT IN NEUTRAL" CIRCUIT IS NOT USED, INSULATE AND SECURE THE BLUE AND BLACK WIRES.

PART NO.	FACTORY SETTINGS
1020584	SEE PAGE 2
1020584A	
1020584B	
1020584C	
1020584D	

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
					F	2		ECN12835	11-15-04
					E	1 & 2		ECN12521	6-30-04
					D	1 & 2		ECN11890	10-15-03
					C	1 & 2		ECN11590	6-03-03
					B	1	F1	ECN11523	4-29-03
G	2	F6	ECN13131	3-23-05	A	1	F5	ECN11418	4-22-03

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MATERIAL: SEE NOTE
HEAT TREAT:
SURFACE TREATMENT:
WEIGHT: kg
WR²: N m²
FIRST USE:
ASSY.:
MODEL:
NAME: CONTROL (MGX ETROLL MODULE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.75
.XX ±0.25
.XXX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

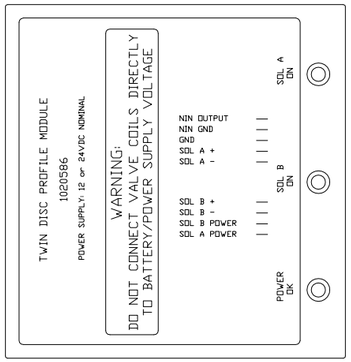
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

DATE: 2-25-03
SCALE: 1 = 1
DRN.: W.Russell
CHK.: R.N.Schenk
APPD.: M.B.Gee

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020584 SERIES

SHEET 1 OF 2 REV G



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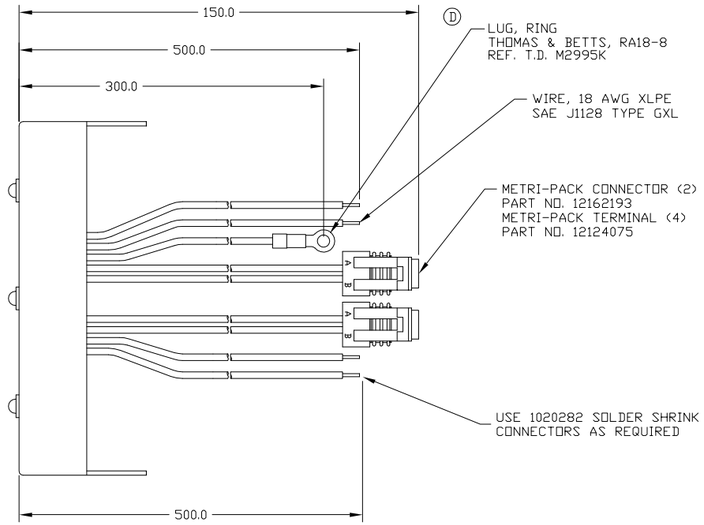

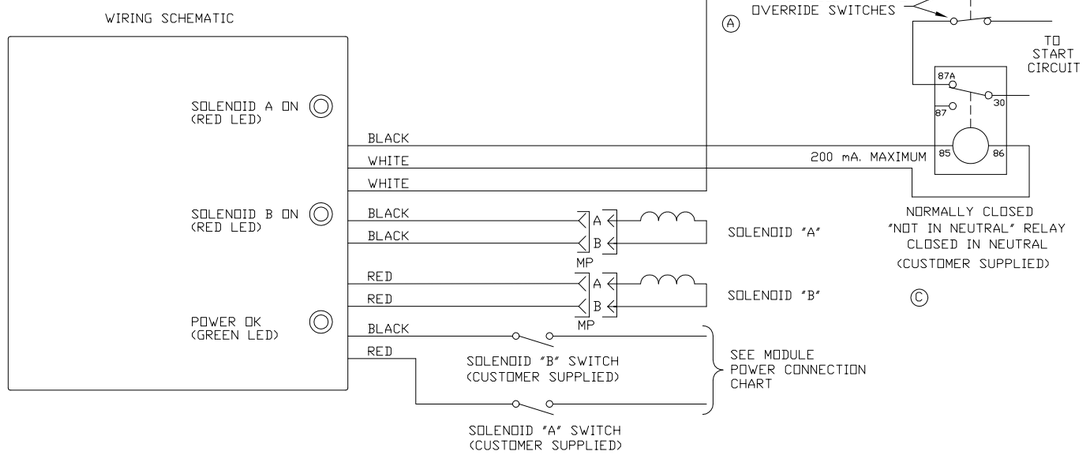

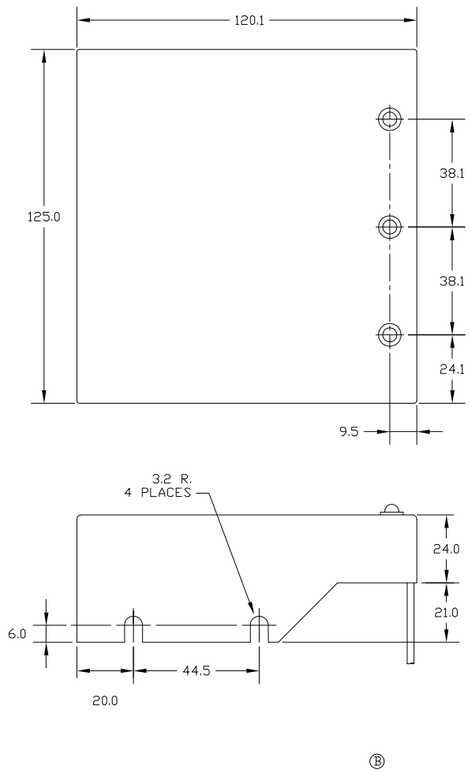

Ⓑ

MODULE POWER CONNECTION CHART

USE OPTION 1 CONNECTIONS WHEN THE MODULE IS CONNECTED TO NON-ELECTRONIC LEVER HEADS.

USE OPTION 2 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC GEAR CONTROLLERS.

USE OPTION 3 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC CONTROL SOLENOID DRIVER OUTPUTS. THE ELECTRONIC CONTROL'S SOLENOID 'A' AND 'B' RETURNS OR NEGATIVE SIGNALS SHOULD BE CONNECTED TOGETHER AND CONNECTED TO THE 'ETROLL' MODULE RETURN. ELECTRONIC CONTROL SOLENOID DRIVERS MUST HAVE THEIR SOLENOID RETURN INTERNALLY CONNECTED DIRECTLY TO GROUND. IF NOT, THE MODULE MUST BE INTERFACED TO THE ELECTRONIC CONTROL WITH RELAYS.

WIRE	WIRING OPTION 1	WIRING OPTION 2	WIRING OPTION 3
SOLENOID B SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE CONTROL'S SOLENOID B POSITIVE DRIVER OUTPUT.
SOLENOID RETURN	CONNECT TO THE NEGATIVE TERMINAL OF THE ENGINE BATTERY	CONNECT TO THE SAME GROUND POINT USED BY THE GEAR CONTROLLER OR THE ENGINE CONTROL.	CONNECT TO THE CONTROL'S SOLENOID NEGATIVE OUTPUT CIRCUIT.
SOLENOID A SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID A.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS USED TO ENERGIZE SOLENOID A.	CONNECT TO THE CONTROL'S SOLENOID A POSITIVE DRIVER OUTPUT.

NOTE: FOR USE ON NOMINAL 12/24 VDC SYSTEMS.

Ⓔ

LED INDICATORS
- GREEN LED ILLUMINATED WHEN POWER IS GREATER THAN 9.0 VOLTS
- RED LED ILLUMINATED INDICATES VALVE COIL COMMANDED ON.
- ONE RED FLASHING INDICATES AN OPEN CIRCUIT IN AN ENERGIZED VALVE COIL CIRCUIT,

Ⓐ NOTE 1: WHEN THE 'NOT IN NEUTRAL' CIRCUIT IS NOT USED, INSULATE AND SECURE THE BLACK AND WHITE WIRES.

• = WIRE SPLICE PART # 1020282
DH = DEUTSCH CONNECTOR
MP = METRIPACK CONNECTOR

PART NO.	FACTORY SETTINGS
1020586	SEE PAGE 2
1020586A	

REV	SHEET	ZONE	CH. NO.	DATE
E	1		ECN12835	11-15-04
D	1 & 2		ECN12521	6-30-04
C	2	A2	ECN11890	10-15-03
B	1	F1	ECN11523	4-29-03
A	1 & 2	F5	ECN11418	4-22-03

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MATERIAL: SEE NOTE
HEAT TREAT
SURFACE TREATMENT
WEIGHT: kg
WR²: N·m²
FIRST USE
ASSY.
MODEL
NAME: CONTROL (MGX PROFILE MODULE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

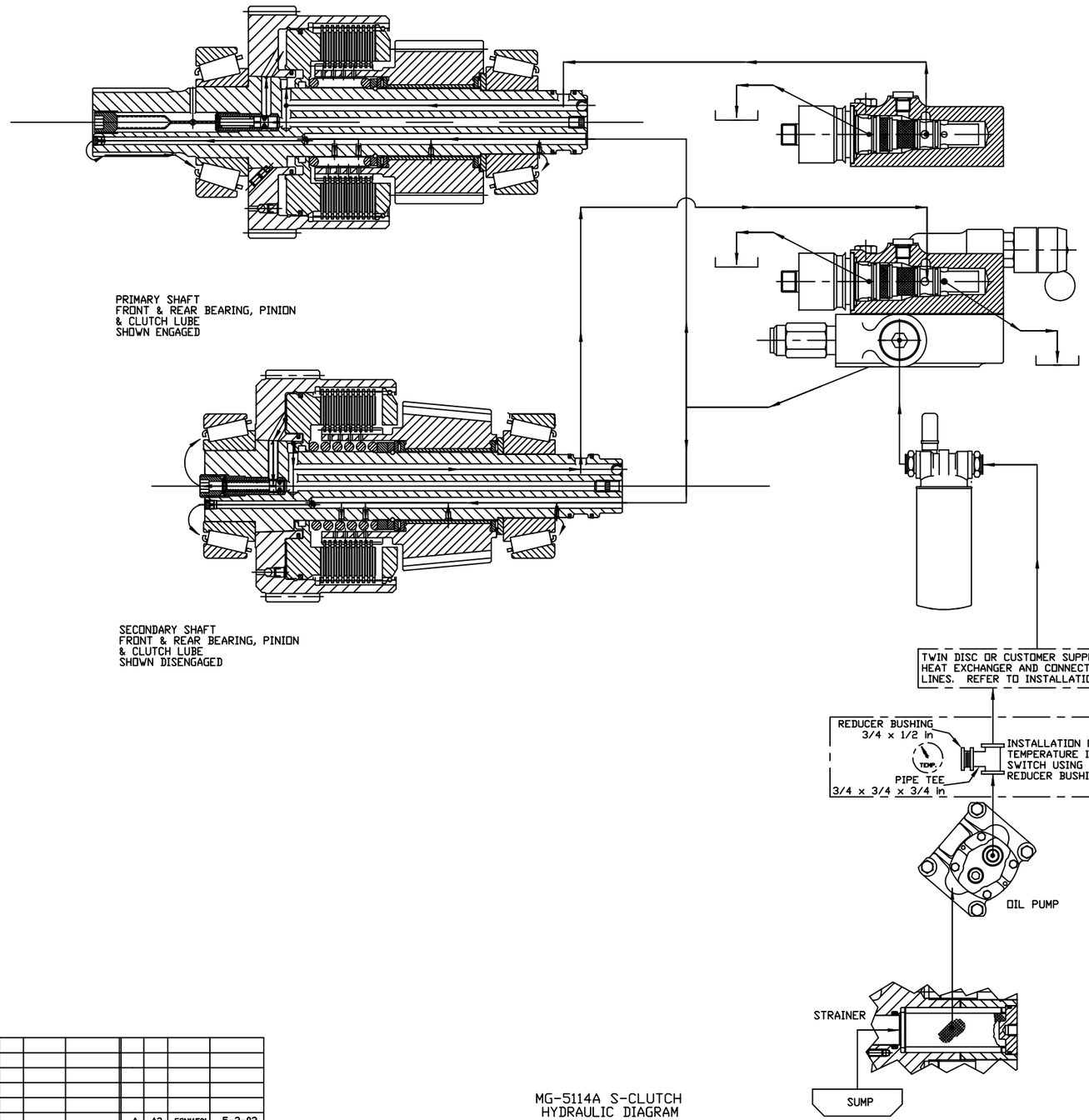
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

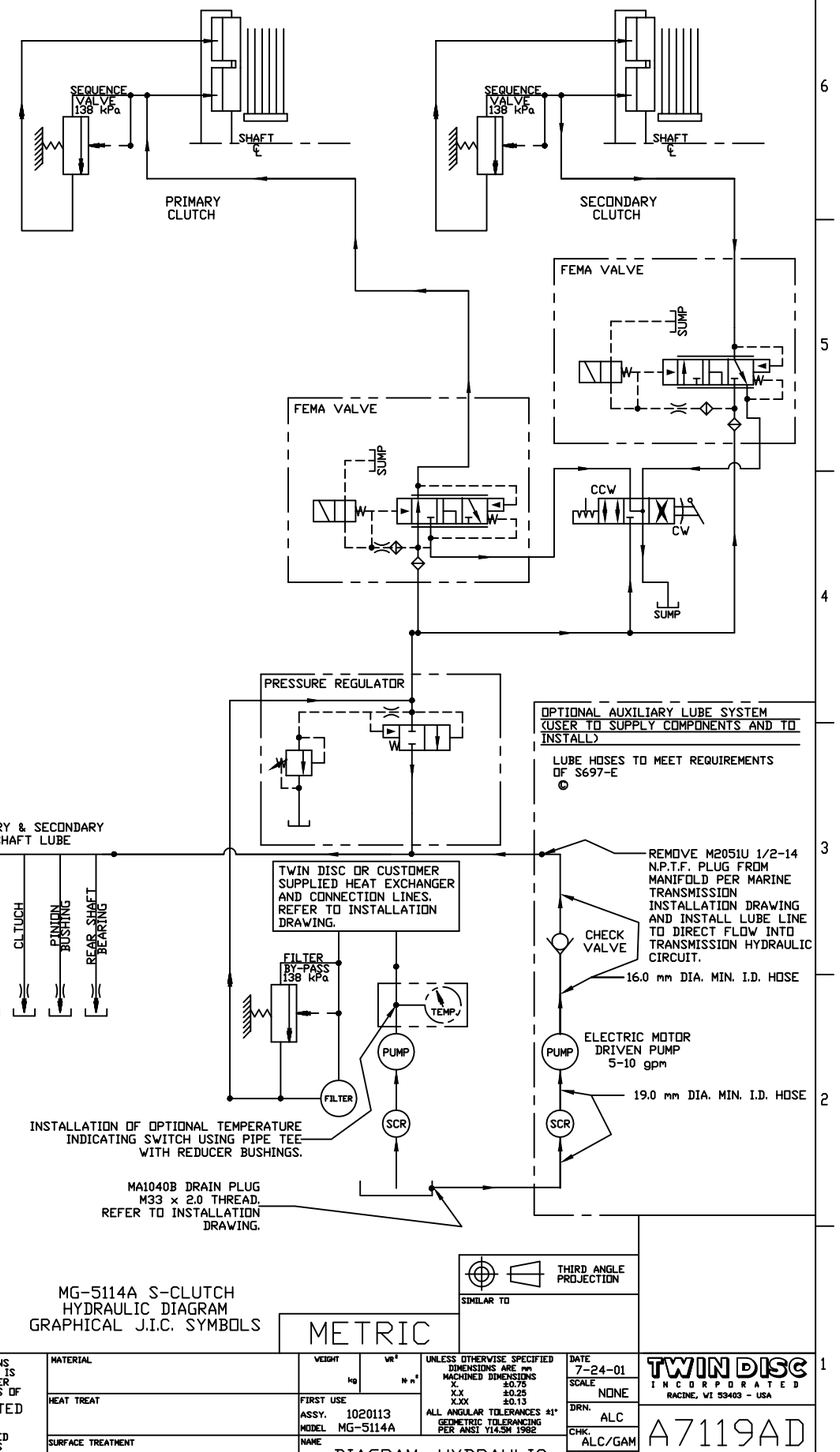
DATE: 7-16-02
SCALE: 1 = 1
DRN. W.Russell
CHK. RNS
APPD. M.B. Gee

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1020586 SERIES

SHEET 1 OF 2 REV E




SEQUENCE VALVE 138 kPa
SHAFT ℄
PRIMARY CLUTCH
SECONDARY CLUTCH
FEMA VALVE
SUMP
W
T
CCW
CW
PRESSURE REGULATOR
OPTIONAL AUXILIARY LUBE SYSTEM
(USER TO SUPPLY COMPONENTS AND TO INSTALL)
LUBE HOSES TO MEET REQUIREMENTS OF S697-E
PRIMARY & SECONDARY SHAFT LUBE
FRONT SHAFT BEARING
CLTUCH
CLTUCH
PINION BUSHING
REAR SHAFT BEARING
TWIN DISC OR CUSTOMER SUPPLIED HEAT EXCHANGER AND CONNECTION LINES. REFER TO INSTALLATION DRAWING.
FILTER BY-PASS 138 kPa
TEMP.
FILTER
PUMP
SCR
CHECK VALVE
REMOVE M2051U 1/2-14 N.P.T.F. PLUG FROM MANIFOLD PER MARINE TRANSMISSION INSTALLATION DRAWING AND INSTALL LUBE LINE TO DIRECT FLOW INTO TRANSMISSION HYDRAULIC CIRCUIT.
16.0 mm DIA. MIN. I.D. HOSE
ELECTRIC MOTOR DRIVEN PUMP 5-10 gpm
19.0 mm DIA. MIN. I.D. HOSE
INSTALLATION OF OPTIONAL TEMPERATURE INDICATING SWITCH USING PIPE TEE WITH REDUCER BUSHINGS.
MA1040B DRAIN PLUG
M33 x 2.0 THREAD.
REFER TO INSTALLATION DRAWING.

MG-5114A S-CLUTCH
HYDRAULIC DIAGRAM
PICTORIAL

MG-5114A S-CLUTCH
HYDRAULIC DIAGRAM
GRAPHICAL J.I.C. SYMBOLS

THIRD ANGLE PROJECTION

SIMILAR TO

METRIC

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
				A	A3	ECN11501	5-2-02

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MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT kg | WR² N m²

FIRST USE
ASSY. 1020113
MODEL MG-5114A

NAME
DIAGRAM, HYDRAULIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE	7-24-01
SCALE	NONE
DRN.	ALC
CHK.	ALC/GAM
APPD.	GAM

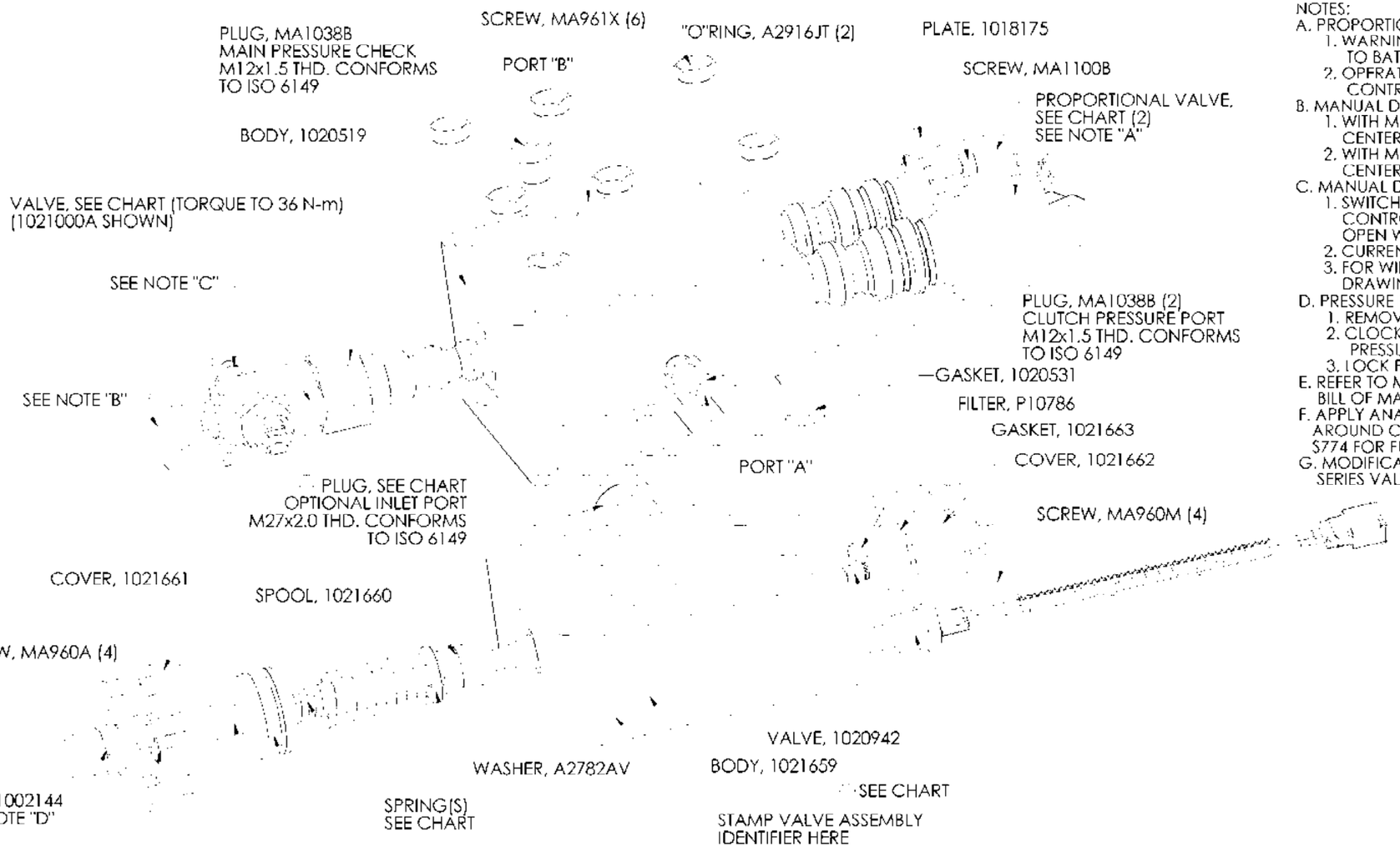
TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

A7119AD

SHEET 1 OF 1 | REV A

F E D C B A

1 2 3 4 5 6



NOTES:

A. PROPORTIONAL CONTROL VALVE OPERATION.
   1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTERY/POWER SUPPLY VOLTAGE.
   2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION.
   1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PORT "A".
   2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE PORT "B".

C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH.
   1. SWITCH IS NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION.
   2. CURRENT = 20 AMPS MAX.
   3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

D. PRESSURE REGULATOR ADJUSTMENT.
   1. REMOVE 1002144 CAP AND LOOSEN 1002145 NUT.
   2. CLOCKWISE ROTATION OF 1020939A PISTON INCREASES PRESSURE. COUNTER CLOCKWISE DECREASES PRESSURE.
   3. LOCK PISTON IN PLACE USING JAM NUT AND REPLACE CAP.

E. REFER TO MARINE TRANSMISSION ASSEMBLY DRAWING OR BILL OF MATERIAL FOR VALVE MOUNTING AND SCREWS.

F. APPLY ANAEROBIC SEALANT MEETING M2828 REQUIREMENTS AROUND CORE PLUG, JUST BEFORE FINAL ASSEMBLY. REFER TO S774 FOR FURTHER INFORMATION.

G. MODIFICATION KIT TO UPGRADE EXISTING 1020729/1020696 SERIES VALVE ASSEMBLIES TO 1021658 SERIES VALVE ASSEMBLY.

VALVE ASSEMBLY PART NO.	VALVE ASSEMBLY IDENTIFIER	BOM	PRESSURE kPa (psi)	SPRING(S)	VALVE	SENSOR	PLUG	PLUG	CORE PLUG SEE NOTE "F"	PROPORTIONAL VALVE	MODIFICATION KIT SEE NOTE "G"
1021658A	A	43110	1795-2205 (260-320)	2013412C 2013412D	1021000A	NONE	M2051S	MA1038E	NONE	1020520	K1417
1021658B	B	43111	1585-1795 (230-260)	2013412C	1021000A	NONE	M2051S	MA1038E	NONE	1018528	K1418
1021658C	C	43112	2205-2760 (320-400)	2013412C 2013412E	1021000A	NONE	M2051S	MA1038E	NONE	1020520	K1420
1021658D	D	43195	1795-2205 (260-320)	2013412C 2013412D	1021000A	1016122A	NONE	MA1038E	NONE	1020520	K1417
1021658E	E	43196	1585-1795 (230-260)	2013412C	1021000A	1016122A	NONE	MA1038E	NONE	1018528	K1418
1021658F	F	43197	2205-2760 (320-400)	2013412C 2013412E	1021000A	1016122A	NONE	MA1038E	NONE	1020520	K1420
1021658G	G	43198	1585-1795 (230-260)	2013412C	1020542	NONE	M2051S	MA1038E	W/SEAT PORT "A"	1018528	K1419
1021658H	H	43199	1585-1795 (230-260)	2013412C	1021000A	NONE	M2051S	MA1185A	NONE	1018528	K1418
1021658J	J	43200	1585-1795 (230-260)	2013412C	1020542	NONE	M2051S	MA1053Q	NONE	1018528	K1418

REV	DESCRIPTION	DATE	APPROVED
B	A2 ECN12561	7-28-04	
A	B3 ECN12537	6-28-04	

DRAWN 1020391
MODEL MC 5222DC
TWIN DISC INCORPORATED

METRIC

VALVE ASS'Y.

5-04-04
FULL
MILLIMETERS
AIC
WITW A1

TWIN DISC
RACINE, WISCONSIN, USA

1021658

B

#1021303 R3 05/05

TWIN DISC, INCORPORATED RACINE, WISCONSIN 53403, U.S.A. 262-638-4000/262-638-4482 (FAX) WWW.TWINDISC.COM